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GEOLOGICAL SURVEY.

ENGLAND AND WALES.

THE WATER SUPPLY OF LINCOLNSHIRE FROM UNDERGROUND SOURCES:

WITH RECORDS OF SINKINGS AND BORINGS.

EDITED BY

HORACE B. WOODWARD, F.R.S.,

WITH CONTRIBUTIONS BY

WILLIAM WHITAKER, B.A., F.R.S.,

H. FRANKLIN PARSONS, M.D., F.G.S.,

HUGH ROBERT MILL, D. Sc., LL.D.,

AND

HENRY PRESTON, F.G.S.

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PREFACE.

This is the third of the County Memoirs dealing especially with Water Supply, but it must not be forgotten that Mr. Whitaker, who has been a pioneer in the matter of recording details of well sinkings and borings, prepared for us a volume of the well sections near London.

Although this work is intended to act as a geological guide for the water-bearing strata of Lincolnshire, it has been deemed advisable to include records of all borings made in the county for whatever purpose, as they are all helpful with regard to the local thicknesses and characters of the strata.

In gathering together the records, those issued in the several Memoirs illustrating the Geological Survey Sheets have formed a substantial nucleus; for many of them we were indebted to Mr. Whitaker, while others were collected during the survey of the county by Messrs Reid, Strahan, Ussher, and Jukes-Browne.

When the present work was planned, Mr. Henry Preston, who had been consulted, generously placed his MSS. containing many records of wells and borings at our disposal, while Dr. H. F. Parsons, whose personal acquaintance with the northern part of the county led him to take particular interest in the volume, has given us much information, and, through his kind offices, the Local Government Board have supplied us with particulars of numerous analyses of waters. We are indebted to Dr. Alfred Ashby, Mr. James Baynes and Mr. Otto Hehner for permission to publish analyses made by them.

Mr. J. Stuart Bogg has sent us particulars of a recent boring at Benniworth, together with copies of analyses of Kimeridge Clay. We are likewise indebted to various engineers, well-sinkers, and others, whose names are mentioned in the text, for records of borings, given generally in return for information supplied at the Geological Survey Office. The records thus received have been annotated by Mr. H. B. Woodward, who has arranged all the other materials, and has written the introductory notes.

The records are published as they have been received, but every care has been taken to define the geological horizons as indicated by the terms used by well-sinkers. It should, however, be remembered that these terms are sometimes inaccurate, as, for instance, when "gravel" is used for broken rock, and "sandstone" for oolite. (See p. 58.)

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In order to illustrate the subject as fully as possible, Dr. H. R. Mill, whose services we were fortunately able to secure, has contributed a report on the rainfall.

Details of the levels of water in wells at different seasons, would have been of much interest and value, but observations on these matters do not come within the province of the Geological Survey, and it has not been possible to collect the information.

J. J. H. TEALL,
Director.

Geological Survey Office,
28, Jermyn Street, London.
23rd November, 1904.

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THE WATER SUPPLY OF LINCOLNSHIRE

FROM UNDERGROUND SOURCES.

Outline of the Geology as far as relates to Water-Supply.

INTRODUCTION.

The geological formations known to occur in Lincolnshire range from the Carboniferous to the Chalk, and include also Pleistocene and Recent deposits.

The formations which occupy the surface are naturally divided into three great groups :—

(1) The Triassic, Liassic and Oolitic series, which extend through the western half of the county, overlie one another in regular sequence, with a gentle easterly inclination, and thus outcrop in successive belts from west to east, with a northerly and southerly strike.

(2) The Cretaceous rocks, which in the north-eastern portion of the county stretch obliquely across the outcrops of the higher Oolitic strata, with an inclination to the north-east and a general strike to north-west and south-east. They comprise a lower sandy and clayey division; and an upper division of Chalk, which forms the Wolds and overlaps the sandy and clayey beds in the northern part of the county.

(3) The Glacial Drifts and other superficial deposits, which occur as great sheets and outlying patches, resting irregularly on any of the older formations in various parts of the county, and entirely concealing them in the south-eastern part.

Strata older than any of those just mentioned have been proved in certain deep borings. These include the Carboniferous and Permian, but as they cannot be regarded as sources of water supply, a brief reference to the rocks will be sufficient.

On the whole the structure of the country as represented by the Triassic and newer strata is fairly simple, and the general easterly and north-easterly dips are subject to but little modification. A gentle anticline is indicated by the inliers of Cornbrash and Great Oolite between Bourn, Folkingham and Sleaford ; and a more important flexure occurs between Alford and Claxby, where the Lower Cretaceous strata have been proved from well-borings to rise in

an anticline and to directly underlie the Drifts. To the east of Alford and Willoughby the Chalk is again present beneath the superficial deposits, and it extends below ground to the coast a little south of Skegness. In the Geological Survey Map a probable line of fault was originally marked between Claxby and Skegness. A fault, with a considerable downthrow to the north had been proved at Claxby, but its prolongation to the south-east in order to account for the Chalk below Skegness need not now be assumed in view of the anticlinal structure.*

Other faults have been met with here and there in various parts of the county, and these are indicated on the Geological Survey map. None appear to be of any great magnitude, but they may be of sufficient importance to influence local supplies of water.

It is probable that the whole of the Fenland south of Bardney and Wainfleet is directly underlain by the Oxford, Corallian and Kimeridge Clays. Beneath this group of clays, or the lower part of them, the Great Oolite series and the Lincolnshire Limestone have been proved in certain places, as at Woodhall Spa and further south. The Great Oolite series, judging from the record supplied by Mr. H. Preston of the well at Crowland, shows considerable modification, the Great Oolite Limestone being absent as limestone, though probably represented by clayey strata. The Lincolnshire Limestone also undergoes attenuation beneath the Fenland.

The principal water-bearing strata, if we exclude the superficial deposits, are the Triassic Sandstones, the Lincolnshire Limestone, the Great Oolite Limestone, the Spilsby Sandstone, and the Chalk.

Shallow wells in any of these formations may be liable to pollution, but in the deeper wells, the supply when obtained from beneath an impervious covering, has had to travel for some distance underground, and is usually of excellent quality. In some cases, however, the deeper wells and also the shallow wells, are impregnated with mineral matter to an extent that renders the water useless for drinking purposes. This more usually happens when the water is derived from strata at a considerable distance from their outcrop.

The following are the geological formations represented in Lincolnshire :—

RECENT	Blown Sand.	
	Alluvium—Fen Beds.	
PLEISTOCENE	Valley Gravel and Loam.	
	Boulder-clay	Glacial Drift.
	Glacial Sand and Gravel	
UPPER CRETACEOUS	Upper Chalk (with flints).	
	Middle Chalk (with flints).	
	Lower Chalk	
	Red Chalk.—Selbornian	

* Jukes-Browne, *Quart. Journ. Geol. Soc.*, vol. xlix., pp. 474, etc.

LOWER CRETACEOUS		Carstone.	
		Tealby Limestone and Roach (ironstone, &c.).	
		Tealby Clay.	
		Claxby Ironstone.	
		Spilsby Sandstone.	
JURASSIC	Oolitic.	Kimeridge Clay.	
		Corallian Clay.	
		Oxford Clay.	
		Kellaways Beds (sandstone, sand, and clay).	
		Cornbrash (limestone).	
		Great Oolite Clay	Great Oolite Series.
		Great Oolite Limestone	
		Upper Estuarine Series (clays and sand)	
		Lincolnshire Limestone	Inferior Oolite Series
		Lower Estuarine Series (clays and sand)	
		Northampton Sand (Dogger)	
	Liassic.	Upper Lias (clay).	
		Middle Lias: Marlstone (Rock-bed).	
		Middle Lias: Clays and sand.	
		Lower Lias (clays and limestones).	
TRIASSIC		Rhætic Beds (shales and marls)	New Red Sandstone Series.
		Keuper Marl	
		Keuper Sandstone (Waterstones), etc.	
		Bunter Sandstone and Pebble-beds	
PERMIAN		Magnesian Limestone (with marls and sandstones)	
CARBONIFEROUS		Coal Measures (sandstones, shales, and seams of coal).	

CARBONIFEROUS.

The oldest strata reached by boring in Lincolnshire are the Coal Measures which were proved at South Carr by Idlestop, about three miles south-west of Haxey, at a depth of 1728 ft. 3 in. and penetrated to a depth of 3185 ft. 2 in. from the surface—the thickness passed through being 1456 ft. 11 in. The beds comprised shales, fire-clay, sandstones, ironstone nodules, and seams of coal.

PERMIAN.

Strata representing the Magnesian Limestone series, with sandstones and marls, were proved at South Carr in the deep boring of which particulars are printed further on. (p. 108.)

Owing to the abundance of gypsum, the water obtained from the formation would be exceptionally hard. The beds were met with at a depth of 1183 ft. 6 in., and penetrated to a depth of 1728 ft. 3 in., when Coal Measures were reached; the thickness of the strata regarded as Permian was 547 ft. 9 in.

TRIASSIC.

Bunter.

Red sandstone with pebbles, and with occasional bands of marl, was proved above the Permian series in the deep boring at South

Carr, at depths of from 746 feet 2 inches to 1183 feet 6 inches; indicating a thickness of 437 feet 4 inches of strata referred to the Bunter.

Bunter Sandstone was also reached at Gainsborough. There the supply from one bore-hole has not been sufficient for the needs of the district, and a second boring has been made.

The exposed areas of the Bunter lie to the west of the county in an isolated tract between Thorne, Doncaster, and Bawtry, and southward over a broad belt through Sherwood Forest to Nottingham.* The general thickness of the Bunter is here about 450 feet.

Keuper Sandstone.

Red and grey sandstones (sometimes in part grouped as Waterstones) with occasional bands of shale or marl, were proved at South Carr between the depths of 137 feet 7 inches and 746 feet 2 inches; the thickness being estimated at 608 feet 7 inches. It should be mentioned that the Keuper and Bunter Sandstones are often so closely connected that it is especially difficult to fix definite limits to them from the evidence furnished by cores. In the neighbourhood of Southwell, however, the Keuper Sandstones are much interbanded with marl, which would interfere with the free circulation of water, and their thickness probably does not exceed 80 feet.

Keuper Marl.

This division, the oldest of the strata exposed at the surface in Lincolnshire, consists of red and variegated marls with occasional bands of sandstone and locally some anhydrite and much gypsum. A thickness of 725 feet of Keuper Marls has been proved at Gainsborough, and the full thickness may be about 800 feet.

Local supplies of water are sometimes to be met with in the bands of sandstone which occur in the lower part of the series. A belt of these sandstones outcrops at Tuxford, to the west of the Trent valley. In some cases, as mentioned by Mr. F. M. Burton, where hard sandy layers are intercalated with the marls, the water that enters into a well may pass quickly away, and the well prove useless.†

The elevation of the land is 50 feet at Crowle Hill, 125 feet at Gainsborough Hill and near Epworth. The soil on these red rocks is for the most part a clay-loam.

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* See Dr. H. F. Parsons, "The Trias of the southern part of the Vale of York," *Proc. Yorksh. Geol. and Polyt. Soc.*, ser. 2, vii., p. 154, 1880; and "The Alluvial Strata of the Lower Ouse Valley," *Ibid.*, ser. 2, vi., 215, 1877.

† "Victoria History" of Lincolnshire, Art. Geology.

Rhætic Beds.

These beds include the following sub-divisions :—

White Lias - - - - - - - -	3 feet.
Black Shales - - - - - - - -	about 25 „
Grey Marls (merging into Red Keuper Marls) -	5 to 15 „

They are not water-bearing, as the White Lias is too thin to hold any useful supply.

LIASSIC.

Lower Lias.

This division consists in the lower part of alternations of limestones and clays estimated to be about 170 feet thick in North Lincolnshire, and about 220 feet thick in the southern part of the county.

Bands of ferruginous limestone and iron-ore, known as the Frodingham Ironstone occur above, to the thickness of 20 or 30 feet in the north, and not more than 5 feet in the south. These are surmounted by a mass of blue clay and shale which increases in thickness from less than 90 feet in North Lincolnshire to 450 feet or more in the south.

Only the lower portion of the Lower Lias, where the limestones are well developed, is water-bearing, and to a limited extent. The alternations of clay and shale prevent any considerable storage or circulation of water, and as a rule supplies are only obtained in shallow wells.

The ground rises to 117 feet at Messingham and 218 feet at Burton-upon-Stather. The soil is for the most part a stiff clay and loam, but a reddish loamy soil marks the outcrop of the ironstones, and from these small springs are given out.

Thackson's well, south-west of Foston, is a perennial spring that issues from the Lower Lias near a line of fault. There is a "petrifying" spring near Whitton. Owing to the difficulty in getting a ready supply of water, there are comparatively few villages on the clay lands occupied by the upper part of the Lower Lias and the lower part of the Middle Lias, as in the Brant valley, and again in the vale north-west of Lincoln where, however, the Lower Lias is much covered with Boulder-clay.

Middle Lias.

This is a variable division, comprising in the lower part micaceous and ferruginous clays and sands from 40 to 80 feet thick. In the upper part there are beds of ferruginous sandstone and ironstone which, however, are not persistent: they are 30 feet thick near Grantham, and are absent from Welbourne northward to Navenby and Lincoln.

In North Lincolnshire the lowest layer is a band of ironstone (Pecten bed) which is taken as a convenient division between Lower and Middle Lias; while the rock-bed is a ferruginous limestone or ironstone from 6 to 8 feet thick.

The ironstone-beds and ferruginous sandstones known generally as the Rock-bed or Marlstone are water-bearing. The water is often very good, but it may be chalybeate. Owing, however, to the impersistent nature of this sub-division it can never be depended upon as a source of supply at a distance from the outcrop.

Where the Marlstone is present it usually yields a brown ferruginous soil.

Upper Lias.

The Upper Lias consists almost wholly of dense blue clays and shales with occasional bands and nodules of limestone, and with a few bands of limestone at the base. Its thickness in North Lincolnshire is about 25 feet, near Lincoln 80 feet, and at Grantham 120 feet.

The basement-limestones may yield a small amount of water which is not separable from that of the Marlstone, in well-sinkings.

OOLITIC.

Lower Estuarine Series and Northampton Sand.

This variable group comprises the following divisions:—

		feet.
Lower Estuarine Series.	Bluish-grey, black, purple, and green clay and shales, white sand, and sand-rock, with lignite and ironstone nodules.	10 to 15
Northampton Beds (or Dogger)	Tough ferruginous sandstones, sands, loam and ironstone - - - - -	5 to 20

These beds hold a moderate amount of water. That from the Lower Estuarine Series is usually impregnated with sulphuretted hydrogen, but the Northampton beds yield good water in many places, and numerous springs are thrown out along their junction with the Upper Lias clay.

The upper and weathered (peroxidized) portion of the Northampton ironstone beds, as remarked by Professor Judd, are open and easily traversed by water, whereas the unweathered layers (carbonate of iron) below are less pervious but yield water, often copious springs, in the joints. The soft weathered rocks in this and other formations are sometimes termed "Kale" by quarrymen and well-sinkers. Near Lincoln the ironstone-beds are directly overlain by the Lincolnshire Limestone.

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* See Geology of Rutland, *Geol. Survey*, p. 116.

Lincolnshire Limestone.

This is the chief water-bearing formation in the county, and indeed its yield especially in the neighbourhood of Bourn is so copious that there we find some of the best artesian wells in England. The Lincolnshire Limestone has a broad outcrop which is but little concealed by Boulder-clay. It extends through the county from Winteringham by Lincoln to Stamford, a distance of more than thirty miles, with a width of two to three miles north of Lincoln, and four to six miles on the south. Its thickness varies from 60 to a little over 100 feet, and rarely to as much as 130 feet.

In North Lincolnshire the following divisions have been made :—

		feet.
Hibaldstow (=Ponton) Beds	Oolite - - - - - - - - - -	20
Kirton Beds	Grey limestones and clays with oolitic limestone at base- - -	45

Near Kirton-in-Lindsey there is about 15 feet of grey shaly clay between the Kirton and Hibaldstow beds ; south of Grayingham and Waddingham, as remarked by Mr. Ussher, the Lincolnshire Limestone becomes more homogeneous. From the fact that in this northern region it is subdivided by clayey beds, it does not yield such noted supplies of water as have been encountered further south. The northern portion is separated at Lincoln by the River Witham from the broader superficial belt to the south. Even at Lincoln and near Nocton there are soft marly beds in the upper part of the division. Underground the formation has been proved to extend eastwards below the Fenland as far as Crowland.

As remarked by Mr. W. H. Penning and Mr. W. H. Dalton, a glance at the Geological Survey map shows a series of villages along the escarpment of the Limestone and a similar series on or near the less regular line bounding the upper limit of its outcrop, their situation having arisen from the all-important condition of water supply. Water was readily obtainable on either side of the tract of open porous limestone in which it is supported on the west by the impervious Lias clay, and on the east by the absence of means of escape, the rock being waterlogged up to or near to the lip of overlying clay in the Upper Estuarine Series, and overflowing in powerful springs.* One of these is at Great Spring Head, S.W. of Dunston. Again to the N.E. of Lincoln, at Welton there are strong springs, one being marked on the map as the "Old Man's Head Spring." These springs, as stated by Mr. De Rance, show marked fluctuations according to the rainfall, proving the rapid circulation of water through fissures in the Lincolnshire Limestone. Thus the

* Geology of the Country around Lincoln, *Geol. Survey*, 1888, p. 45 ; see also De Rance, *Proc. Yorksh. Geol. and Polyt. Soc.*, xii., 29.

amount of water, as gauged by Mr. Teague, has varied from 105,000 gallons to 2,800,000 gallons (after heavy rainfall).* (See Fig. 1.)

Fig. 1.

Diagram-section of the Oolite plain south of Lincoln. (*W. H. Dalton.*)

Villages. Villages.

A. Upper Lias. B. Lincolnshire Limestone. C. Upper Estuarine Series, etc.

D, D, D. Line of perennial saturation, with springs at the points of intersection with the surface.

Mr. J. Addy mentions that "One of the main branches or tributaries of the River Glen has cut its channel partially through the Estuarine Clays for some miles above Braceborough Spa. This channel may be said to be a groove cutting more and more deeply into the clays, as the river falls in its course, and thus continually approaching the limestone under it, which bears the subterranean waters, until a point is reached when the stratum of Estuarine Clays under the groove, owing to its thinness, or perhaps 'faulty' nature, can no longer form an impervious division, or resist the upward force of the imprisoned waters. This point occurs in the river about 2 miles, measured up its course, above Braceborough Spa, and from it to the latter place the river is studded with springs, throwing up water with such force as to show distinctly above the surface of the rapidly-flowing stream. These eruptions, appearing at first singly, and at wide distances apart, gradually reach a climax lower down at 'The Caudles,' and again at Braceborough Spa, at both which spots the beds of the river, and of streams and pools adjacent, seem to some extent riddled by the number of vents for these waters."

"Mention ought also to be made of the noted 'Well Head' at Bourne, as a display of this water in the form of natural springs, yielding, when gauged in 1874, at the rate of 4,600,000 gallons in twenty-four hours. At Horbling, too, there is a natural spring of some note."†

Among other examples are the Norcliff Spring at Wilsford, near Sleaford; the Lady Well at Ancaster, the Holy Well at Fulbeck, between Grantham and Lincoln; the springs that issue at the head

* *Proc. Yorksh. Geol. and Polyt. Soc.*, vol. xii., p. 32.

† *Proc. Inst. Civ. Eng.*, lxxiv., 1883, 143.

of the combe, one mile and a quarter N.E. of Lincoln; and a spring at Stoke Rochford, near Colsterworth, south of Grantham, which is said to yield about 4,000 gallons a minute.

A " Blow Well " (see p. 15) is said to occur south-west of Hibaldstow.

The escarpment rises from 72 feet at Winterton to 250 at Sawcliffe, 239 at Hibaldstow Cliff, 227 at Hemswell Cliff, and 213 feet at Lincoln. In the area south of Grantham the Lincolnshire Limestone is much covered by Boulder-clay.

The soil is a brashy one with reddish-brown clay, and for the most part dry.

Upper Estuarine Series.

This division consists of white sands, coloured clays often green, shales with lignite, shelly marls, and limestones, with ironstone nodules at the base. In thickness it is from 20 to 35 feet.

Limited supplies of water are locally held in the sands and limestone bands, but the water, like that of the Lower Estuarine series, is not usually palatable.

Great Oolite Limestone.

This comprises hard shelly and occasionally oolitic limestones, with shales and marls; together having a thickness of 12 to 25 feet. The beds yield moderate amounts of water suitable for local supplies.

The Great Oolite Limestone forms a gentle escarpment, rising at Normandy Cliff to 126 feet. The formation disappears to the north of Brigg, and it is not persistent beneath the Fenland, being doubtless to some extent replaced by clayey and sandy strata. (See records of borings at Crowland and Deeping St. Nicholas.)

Great Oolite Clay.

Like the Upper and Lower Estuarine series this division consists chiefly of coloured clays, dark grey, purple and greenish, with also beds largely made up of oysters, and occasional seams of lignite. Ironstone-nodules often occur at the base. In thickness it is from 5 to 35 feet. The strata are not water-bearing, as there appear to be few sandy intercalations.

Cornbrash.

At the surface this appears as a rubbly fossiliferous limestone, and like other limestone strata it occurs in more solid layers at a depth. It is from 3 to 15 feet thick and locally yields small supplies of water. It diminishes in thickness towards the north.

Oxford Clay and Kellaways Beds.

The Kellaways beds at the base of the Oxford Clay consist of an alternating series of buff sandstones, sands, loams and clays, with usually clay or shale from 7 to 18 feet thick at the base. The

sandy beds may hold a useful amount of water, where they are prominently developed, as near Sudbrooke Holme; but as a rule the supply would be small, and it is seldom good in quality. The Oxford Clay consists of dense clays and shales with septaria, and varies in thickness from about 300 feet in North Lincolnshire to 400 feet and perhaps more in the southern part of the county. The Oxford Clay is impervious, and the soil is a heavy clay. The formation is, however, largely concealed by Boulder-clay and other Drift deposits.

Corallian.

This division, represented in Lincolnshire by black clays with much selenite, is about 15 feet thick, and is impervious. It is largely concealed by Boulder-clay.

Kimeridge Clay.

This formation comprises dark shaly clays and bituminous shales with septaria, and is about 320 feet thick. It is almost wholly impervious, but at the brick-kiln near South Willingham, according to Mr. A. Strahan, "Below the layer of septaria there occur bands of hard inflammable oil shale, locally known as "dice." The bands are 4 to 6 inches thick, and are separated by blue clay. . . . About Willingham water is got in some of the shallow wells from the beds of dice. Some of the water is ferruginous and smells offensively."

The formation is extensively hidden by Boulder-clay and other Drift deposits. The soil is stiff clay.

LOWER CRETACEOUS.

Spilsby Sandstone.

This division consists of green, white and brown sands and sandstones, the latter sometimes pebbly and indurated into a very hard calcareous grit: phosphatic nodules occur at the base.

It varies in thickness from 6 feet near Claxby to 50 feet on the south, and 20 feet near Spilsby. The Spilsby sandstone is a good water-bearing stratum, and numerous villages are situated along its outcrop, for, as pointed out by Mr. Jukes-Browne, strong springs gush out at many points along the line of its junction with the Kimeridge Clay. These springs are occasionally ferruginous.

In the dales on the western side of the Steeping valley, there are two springs which have attained celebrity, the "Lady Well" at West Keal, and the "Holy Well" at Somersby. In the case of the Lady Well the gathering ground appears to be about 150 acres

* Geology of the Country around Lincoln, *Geol. Survey*, p. 81.

in extent, while the thickness of the Spilsby Sandstone is not more than 35 feet, and it is noteworthy how small a collecting area will support a perennial spring.*

Tealby Series.

This series is divided into :—

Tealby Limestone { Upper Ironstone and clay / Roach Ironstone
Tealby Clay
Claxby and Hundleby Ironstone.

The united thickness is about 225 feet at Skegness and 100 feet near Spilsby, and it may be said to vary from 135 feet at the southern end of the Wolds to a foot or two at Elsham, owing to the uncomformable overlap of the higher Cretaceous beds. The thickness at Tealby is 65 feet, near Nettleton 45 feet, and at Audleby 10 feet.

The lowest beds, which comprise the Claxby and Hundleby ironstone, consist of ferruginous clay with grains of oolitic iron-ore, and this iron-ore sometimes occurs in mass about 9 feet thick and sometimes as occasional beds in yellow loam 6 to 14 feet in thickness.

The Tealby Clay consists of tough blue clays with selenite, oolitic iron-ore and small septarian nodules ; it is 28 feet thick at Tealby, 40 feet at Claxby, 70 or 80 feet thick near Dalby, and 180 feet or more at Skegness.

The Tealby Limestone consists of hard limestones with shaly partings. It is about 14 feet thick at Claxby, but thins away northward. It appears to pass into the Roach, a soft yellow ferruginous marl with grains of oolitic iron-ore, or into a hard ironstone or ferruginous limestone, estimated at from 20 to 40 feet thick.

The Upper ironstone and clay comprise local beds of clay with grains of oolitic iron-ore, and are about 25 feet thick.

The Tealby beds do not appear to furnish any noteworthy amount of water.

Carstone.

This division consists of red sand, sandstone, and pebbly gravel, 10 to 14 feet thick near Claxby, but thickening south-eastward, being 20 feet near Thoresway, 25 feet at Tealby, and 40 feet further south.

The strata are water-bearing, and springs issue from the base. At Rothwell south-east of Caistor there are springs which issue from an inlying tract of the Carstone.

The Lower Cretaceous rocks rise to 124 feet at Spilsby, to 200 feet at Tealby, 232 feet at Donnington-on-Bain, and 300 feet at Nettleton Hill. They were originally grouped as Lower Greensand.

* Geology of East Lincolnshire, *Geol. Survey*, p. 135.

UPPER CRETACEOUS.

Red Chalk.

This is a bed of nodular and earthy red chalk 4 to 12 feet thick, with often at the base layers of red, green, yellow or grey marl or clay which serve to arrest the downward percolation of the water from the Red and White Chalk, and to throw out springs. "Sometimes water oozes out along the line of junction for a distance of many yards, but more usually it issues in considerable quantity at a single spot which is always in a deep recess or at the head of a valley."*

Chalk.

The Chalk is sub-divided as follows† :—

Upper Chalk with flints (thickness not ascertained).
Middle Chalk with flints, 80 to 100 feet.
Lower or Grey Chalk, 75 to 80 feet.

The Lower Chalk consists of harder and softer beds of grey and white and occasionally pink chalk, and grey shaly marl. It includes in the middle a nodular bed with green-coated nodules, equivalent to the Totternhoe stone. In north Lincolnshire the thickness is about 70 feet.

The Middle Chalk, as pointed out by Mr. C. Reid‡, extends along the eastern margin of the Wolds as an ancient buried and degraded sea-cliff, against which the Glacial deposits abut. This tract is part of the old bay of Holderness; and on the south-side of the Humber the cliff extends through Thornton, Ulceby, Keelby, Laceby, Hawerby, and Ludborough. The lower portion of this Chalk is a hard greyish or yellowish chalk without flints, about 10 to 15 feet thick, the main mass, 70 or 80 feet thick, is a white compact chalk with layers and scattered nodules of grey flints. There is no distinct representative of the Melbourn Rock.

The Upper Chalk, the extent of which has but recently been recognised by Mr. William Hill, consists of firm and hard chalk with softer layers and occasional bands of grey marl. Nodules and large lenticular masses of grey flint occur, the latter being tabular and forming continuous floors over considerable spaces. They are liable, therefore, to interfere with the free circulation of water.

Mr. Jukes-Browne remarks that no exposure of the Upper Chalk is known to exist in that part of the Wolds south of Louth, but some portions may be present on the high ground between Driby

* A. J. Jukes-Browne, Geology of East Lincolnshire, p. 136.

† For details see Jukes-Browne, Cretaceous Rocks of Britain, *Geol. Survey*, vol. ii., pp. 216, 478 ; vol. iii., p. 271.

‡ Geology of Holderness, *Geol. Survey*, 1885, p. 1 ; see also Geology of parts of North Lincolnshire, etc., *Geol. Survey*, 1890, p. 113.

and Rigsby. Upper Chalk occurs at North Elkington, Fotherby, North Ormsby, Wyham, Hawerby, Wold Newton, East and West Ravendale, Hatcliffe, Irby, Riby, and in the neighbourhood of Kirmington, Burnham, and Barrow-upon-Humber. It also extends eastward beneath the Glacial and Alluvial deposits of this north-eastern part of the county.

Mr. Jukes-Browne points out that while in Lincolnshire the escarpment of the Chalk is a conspicuous feature, yet "the thickness of Chalk which crops out below its summit ridge is small (less than 100 feet), and the greater part of the frontal slope consists either of Lower Cretaceous beds or of Jurassic clays, according as the Chalk oversteps the one series on to the other." Thus the escarpment of the Chalk is only the upper part of the slope which forms the descent from the Wolds. Again, there is seldom any second slope or rise from the outcrop of the Lower Chalk to that of the higher beds of Chalk, "and as a rule the escarpment ridge is the dominant feature, forming a continuous watershed, and separating the valleys of the Wolds from those of the country to the westward."

"There are, however, two breaks in the continuity of the escarpment, one near the southern end, where the valley of the Calceby beck cuts completely through the Wolds, running from west to east; the other north of Donnington, where it is deeply indented by the head waters of streams which unite to form the river Bain. Beyond this point, and all through North Lincolnshire, there is a continuous escarpment ridge, except that at Melton Ross there is a well-marked depression or pass, which appears to be a truncated valley. Everywhere the frontal edge of the escarpment is a more or less sinuous line, with frequent combes and recesses, which have been eaten out by the action of rain and springs.*"

The following are some of the elevations attained by the Chalk Wolds:—

Saxby Wold, 329 feet
Elsham Hill, 300 feet.
Somerby Top, 300 feet.
Audleby Top, 331 feet.
Fonaby Top, 463 feet.
Normanby-le-Wold, 548 feet.
Bully Hill, near Tealby, 461 feet.
Near Gayton-le-Wold, 453 feet.
Goulceby Top, 455 feet.
East of Cawkwell, 488 feet.
Rosin Hill, West of Oxcombe, 427 feet.
Tetford Hill, 468 feet.

Mr. Jukes-Browne has further pointed out that "On the Chalk Wolds no water is obtainable without sinking through the Chalk into the Carstone, and along the central part of the range or

* Cretaceous Rocks of Britain, vol. iii., p. 413.

watershed the supply so obtained is often very small, and runs short in the summer time, although the springs at the outcrop continue as usual. This is the case along the high ground near Ulceby and Driby High Barn west of Alford, where the Chalk is over 200 feet thick. The reason of this is probably that the water which falls on the Chalk, and reaches the base of that rock, makes its way quickly either to the west or east, so that in dry seasons little is left along the central line beneath the watershed. In the winter the supply is generally abundant, and where the Wolds are trenched by deep valleys, as near Burwell, Haugham and Maidenwell, intermittent springs and winter-bournes often make their appearance," as in the case of Skirbeck.

As remarked by Mr. Reid, the water supply on the eastern side of the Wolds is mainly obtained from three sources :—natural springs from the Chalk, "blow wells" on the low lands, and artesian borings which tap the Chalk underlying the Drift. Along the eastern slope of the Wolds many powerful springs rise, but several of them being intermittent are quite untrustworthy for water-supply.*

Fuller reference has been made to these waters by Mr. Jukes-Browne, who observes that strong springs break out along the line where the Boulder Clay is banked up against the cliff or steep slope of Chalk. "As the depth of Boulder-clay at a few hundred yards distance from the boundary line is from 60 to 90 feet, it is evident that this impervious mass obstructs the flow of the water which is percolating eastward through the Chalk, and forces much of it to the surface; the result is that a number of perennial springs, affording an excellent and abundant supply of water, break out at those points along the line where the level of the ground is lowest, and generally where one of the dry valleys that trench the Wolds opens on to the Boulder-clay plain. It may be useful to give a list of these here, commencing with the southernmost :—

1. At Welton, west of the Church.
2. At Claxby, about 300 yards west of Church.
3. At Well, one furlong N.E. of Church.
4. At Haugh, about six furlongs N.N.W. of Church.
5. At Belleau, between the Church and the Hall.
6. At Muckton, 200 yards N.E. of Church.
7. At Cawthorpe, by roadside below the Church.
8. At Louth, Aswell, and St. Helen's springs.
9. At North Ormsby, near the Church.

"Besides these strong springs are thrown out under similar circumstances at Tathwell, Maltby, Raithby, Withcall, Welton-on-Wold, and at the Silver Springs west of Louth, where the town waterworks are situated."†

* Geology of Holderness, *Geol. Surv.*, 1885, p. 126.
† Geology of East Lincolnshire, p. 136.

More than fifty years ago Mr. J. A. Clarke observed that "as the chalk dips under the clays and marshes great numbers of wells have been sunk down to it in order to obtain good water with little trouble, and the purest fresh water rises plentifully through the borings to the level of the surface." He added that in some localities there are natural outlets called "blow-wells," "which furnish an unceasing supply of water from the chalk beneath."*

These, as pointed out by Mr. Reid, "are springs which rise through Drift or Alluvium in the middle of the flat lands. They generally bubble up from the bottom of small pools of perfectly clear water, and are connected with some porous bed considerably beneath the surface. The name probably refers to the constant play of the white sand at the bottom of the pools; for bubbles of gas are only disengaged in a few of them, and not, as far as I have seen, in the larger ones."

Attention was called to the blow wells in 1816 by Edward Bogg, who stated that "their depths have never yet been ascertained, but we cannot entertain a doubt of their communicating with the chalk. These wells overflow with a greater flux at the time of high water, and particularly at spring tides."†

During the construction of the Albert Dock at Hull great trouble arose from "boils" or "spouts" at the base of the excavation, which, charged with yellow sand, burst into the works. The water was brackish, but it was regarded as due probably as much to land water as to any connection with the Humber.‡

The following particulars are given by Mr. Reid:—

"South of the Humber there is a Blow Well about a mile west of Barton, and another a mile east of the village, on the Warp. Perhaps the southern branch of Barrow Beck also rises in one, but there are also a number of artificial wells to supply the water-cress beds.

"Along the course of the Ulceby Beck there are several Blow Wells, which apparently rise out of the Inter-glacial Gravels, where they pass under the Boulder Clay. Two of these are on the Alluvium at Thornton Moor, and there is a group on the Alluvium south of Ulceby; these latter may rise either from the Gravels or directly out of the Chalk.

"Keelby Springs also rise near the point where the Boulder Clay overlaps the Gravels, and so does a Blow Well on the Alluvium north of Laceby. Along Laceby Beck there are several Blow Wells, all probably rising from this bed of Gravel, which must be close to the surface, though not always actually bare.

"Between Grimsby and Little Coates lie the group of Blow Wells which now supply Grimsby with water. They form several pools

* Farming of Lincolnshire, *Journ. R. Agric. Soc.*, xii. (1851), 273.
† *Trans. Geol. Soc.*, vol. iii., p. 394.
‡ J. C. Hawkshaw, *Proc. Inst. Civ. Eng.*, xli. (1875), 98.

of clear water, which yield a supply sufficient for the town, though a great deal runs to waste. These wells are more than three miles from the bare Chalk, but they occur at a point where the Interglacial Gravels again outcrop.

"The origin of the Blow Wells just described is not satisfactorily made out, for the bed of Gravel from which they appear to spring has a small outcrop, and is quite incapable of yielding so large a supply of water; there is also no evidence of direct connection with the underlying Chalk. The most probable explanation is that the water is Chalk water, not obtained direct, but flowing for a mile or more through the Gravel, which abuts against the buried Chalk cliff below the line of saturation. The thinning-out and overlap of this Gravel as we go eastward will account for the same springs not being tapped in the numerous borings which pass through the Boulder Clay, and obtain their supply from the Chalk. Occasionally the springs are tapped. Mr. Cordeaux, on deepening the cellar of his house at Great Coates, broke into a bed of sand, which yielded so copious a supply of water that it needed the laying down of a special drain to carry it away.

"Close to Tetney there is a group of seven or eight Blow Wells on the Warp, the origin of which is much more difficult to understand. A farmer stated that he had lowered a heavy weight to a great depth in one of them, and found no bottom. There is also no trace of the Gravel in the immediate neighbourhood; and Mr. Jackling states that close to the Wells he bored 63 feet in clay before reaching the Chalk, and at Tetney village there was 81 feet of clay. From this it would appear that at Tetney Blow Wells the water must rise direct from the Chalk. How the water has penetrated the 63 feet of clay is not clear, but probably these Wells originated when the land was at a higher level, and instead of an Alluvial flat at this point there was a steep-sided valley cut 40 or 50 feet lower—perhaps sufficiently low to tap the Chalk or an immediately overlying sand bed.

"Though the natural water supply of Holderness is, as a rule, not good, an artificial supply is so easily obtained, and the mode of obtaining it so well understood, that nearly every farm has a well down to the Chalk.

"These wells are usually bored through an average thickness of 70 or 80 feet of Drift or Warp, and water is generally found within 20 feet of the top of the Chalk. On the low grounds the water often overflows directly the Chalk is reached. The borings are made very cheaply, so much so that six or seven have been made merely to supply the watercress beds at Barrow.

"At Sunk Island (on the Yorkshire side of the Humber) the water from the Chalk is brackish. But this does not appear to be the case elsewhere on the borders of the Humber, for there are numerous wells of good water on the warp lands of Lincolnshire.

"Wells on the Humber Warp near Great Coates are sometimes affected by the tide, but none of them appear to be brackish.

"Close to the pier at Cleethorpes there is a boring which supplies a drinking fountain. Formerly this yielded 200 gallons in five minutes, overflowing 2 feet above the surface; but the supply is now much less, the bore having apparently become clogged. Another boring at Cleethorpes, in the bed of the Humber, 400 yards below high-water mark, yielded 100 gallons per minute, forcing a jet 16 feet higher than the ground. There is another similar well on the warp near Humberstone."*

Superficial or Drift Deposits.

Pleistocene.

Glacial Sand and Gravel.

These deposits comprise fine and coarse gravel and sand, with flints, quartz, quartzite, and fragments of Jurassic rocks and fossils, also occasional boulders and layers of loam or clay. The thickness varies from a few feet to 30 feet and upwards. There are gravels and sands above as well as below the Boulder clay, and occasionally water is obtained from irregular seams of sand and gravel in the Boulder clay. In certain areas the Glacial sands have been wind-drifted, as on Nettleton Common.

Springs that issue from the Glacial Drift are of variable quality, the waters being sometimes unpalatable, from the presence of salts of iron, etc., but good local supplies are often obtained from them and from wells.

Boulder Clay.

Much of the Boulder clay is a tough tenacious clay, brown, bluish-grey and purple, with numerous fragments of chalk, flints, and many stones and boulders, and sometimes with large transported masses of rock. On the Wolds the Boulder clay is for the most part very chalky, while on the eastern side of these hills it is a brown stony loam, sometimes termed the Hessle Beds.

The thickness reaches 30 feet, or more, as in some cases the Boulder clay occupies deeply eroded hollows. It extends over a good part of the vales of the Lias, Oxford and Kimeridge Clays, over the southern tracts of Lincolnshire Limestone, and along the eastern borders of the Chalk Wolds.

Valley Gravel.

These gravels do not differ materially in composition from the Glacial gravels, but are more generally stratified. Beds of loam are occasionally met with.

* Geology of Holderness, pp. 128–130.

Mr. J. A. Clarke has remarked that, "From Tattershall, through Coningsby, Tumby, Mareham, Revesby, etc., the same sandy gravel forms the surface, except in those places where the clay is left bare. In these and neighbouring parishes there is everywhere plenty of water, which breaks out of the hills in springs, and these, if not cut off, find their way into the fens below."* Good local supplies have been obtained from wells, but these are liable to pollution, especially in towns and villages.

RECENT.

Blown Sand.

Much wind-drifted sand occurs inland as well as on the sea-coast, and sometimes attains a thickness of 50 feet. Inland it occurs along the foot of the great escarpments of the Chalk and Oolites, and sometimes it is banked up against the slopes.

Mr. Jukes-Browne observes that

"Along the landward edge of the sand hills which border the coast fresh water is often obtained in shallow wells. This is the case at Skegness, Sutton, Mablethorpe, and other places, and there can be no doubt that the supply is derived from the local rainfall stored up at the base of the sand hills, though the width of these is in many places less than 100 yards. The supply is generally sufficient for the cottages built near the sand hills and only fails in very dry seasons."†

Alluvium.

The Alluvium is composed of peat, clay, marl, and silt, the silt giving rise to a lighter soil of sandy loam or "warp," which holds a small amount of water. The strata are irregular and variable, and they attain a thickness in places of 50 feet or more.

The estuarine waters of the Humber are bordered by alluvial flats and salt marshes, drained by the Idle and Torne, and by numerous artificial channels, and formerly by the Don.‡

In the marshland of North Lincolnshire (Isle of Axholme Rural District) the alluvial strata, noted by Dr. H. F. Parsons, commonly comprise from above downwards :—

1. Warp, naturally or artificially deposited.
2. Peat.
3. Sand.
4. Laminated clay, often of considerable thickness.
5. Sand and gravel.

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* *Journ. Roy. Agric. Soc.*, xii., 276.

† Geology of East Lincolnshire, p. 137.

‡ Dr. H. F. Parsons states that the old Don, though still spoken of locally as "the river Dun," is now silted up, and its course in most places is scarcely to be traced. It does not serve as a drain at all, but its site still forms the county boundary, and the villages are situated along it. See footnote, p. 4.

Shallow wells have been constructed in these strata in many places, but owing to the defective drainage the water, especially that taken from above the laminated clay, is liable to pollution.

The amount of Alluvial lands in Lincolnshire has been estimated at upwards of 500,000 acres. Much of the land is but 9 or 10 feet above O.D., and rarely as much as 20 feet; and some of the levels vary from 4 to 16 feet below high-water mark of the German Ocean. The country is intersected by dykes.

The peaty areas have "a natural tendency to hold water and continue in a swampy state. The great district extending between Lincoln, Wainfleet, Deeping, and the Nene estuary, is of this conformation." There is peat also in the Trent and Ancholme valleys.

The rivers pour down, in wet seasons, the accumulated floods "upon the fens at their lowest points, when they at once lose their velocity and momentum." It has therefore been necessary to conduct them across the lowlands between high and strong embankments. "Nevertheless the fall thus secured is very trifling, only from three to four inches per mile." Barrier banks have been erected to fence out the tides, and means have been provided for drawing off the water. Thus the Ancholme has been straightened and turned into a canal called the New River.

The marsh grounds have been embanked, "and the issue of the land-waters regulated by sluice-doors in the banks, emitting the freshes when the tide sinks beneath the level of the inside water, and preventing the ingress of the sea when risen above a certain level."*

A soaking in of saline water has affected many wells and ponds in the marshlands. The depth of the ground-water or "Soak" varies, but at times it rises to the ground-level.

Great difficulty has always existed in the Fenland areas in obtaining a proper supply of drinking water. Rain-water cisterns have been constructed, but in most cases it appears desirable, as Dr. Parsons has pointed out, that the water be filtered before entering the underground cisterns.

Dr. R. Bruce Low, writing in 1893, says that the water of the Trent is used for drinking purposes by villagers in the Gainsborough and Glanford Brigg Rural Sanitary Districts; and yet "almost from its source the Trent becomes polluted with sewage."

The water is drawn at low water, just before the tide begins to flow again, as the water is brackish at high tide. At spring tides, owing to the "Eygre" or tidal wave, good water cannot be obtained, and a stock is laid in beforehand.

Dr. Low concludes that in the regions bordering the Trent "Water drawn from the canal or from the rivers would seem especially dangerous; not only by reason of the known pollutions which have

* The quotations above are from a paper by Mr. J. A. Clarke, *Journ. Roy. Agric. Soc.*, xii., 289.

access to them, but also because the sanitary authority can have no power to prevent the pollution of these waterways by strangers suffering from communicable disease." Until safer supplies have been procured, "the best security to be had is obtained by boiling all water used for drinking purposes."*

The superficial areas occupied by the various geological formations in Lincolnshire have been calculated by planimeter, from the one-inch Geological Survey maps by Mr. Henry Dewey.

The results are as follows, the areas being given in square miles :—

——	Pervious and partially pervious.	Mainly impervious.	Percentage.
Alluvium and Gravels	1241.65	——	47·37
Boulder Clay	——	526.31	20·07
Cretaceous	236.25	——	9·01
Upper Oolitic Series (Kimeridge Corallian and Oxford Clays)	——	111.79	4·26
Lower Oolitic Series (Cornbrash Great & Inferior Oolite Series)	296.01	——	11·29
Liassic	——	191.32	7·30
Triassic Keuper Marl	——	18.71	·70
	1773.91	848.13	
		1773.91	
	Total area	2622.04	

From this statement it appears that the pervious and partially pervious formations occupy about $\frac{2}{3}$ of the superficial area, and the mainly impervious formations about $\frac{1}{3}$ of the area. The Alluvial areas have elsewhere (p. 19) been estimated to occupy about 800 square miles, so that the various Gravels and Sands would extend over about 400 square miles. It should be mentioned that the area of the county in 1891 was given as 1,693,547 acres, or a little over 2,646 square miles; and that the above estimates are based on that area, exclusive of the recent marine sand and shingle.

The area of registration for the county in 1901 is given at 1,659,930 acres, or a little over 2,593 square miles.

The following statistics with regard to the county (taken from the *Agricultural Returns*, Board of Agriculture, 1904) may be of interest :

Year	Area in Cultivation.	Area under Corn Crops.	Area under Green Crops	Area under Fallow.	Area under Permanent Grass.
1900	1,518,195	562,504	249,247	18,388	499,203
1904	1,520,392 acres.	553,426 acres.	241,356 acres.	34,163 acres.	504,783 acres.

* Report to Local Government Board, 1893.

THE RAINFALL OF LINCOLNSHIRE.

BY HUGH ROBERT MILL, D.Sc., LL.D.

Secretary Royal Meteorological Society, Director of the British Rainfall Organization.

The accompanying Map represents the distribution of rainfall over Lincolnshire as the average of thirty-five years' observations, the period running from 1868 to 1902. The data were collected for the most part by the late Mr. G. J. Symons, F.R.S., who founded the system of obtaining and publishing rainfall observations in the British Isles known as the British Rainfall Organization, and they were published annually in "British Rainfall."

The Great Central Railway has set an example which other railway companies might follow with advantage in maintaining observations of rainfall at most of the railway-stations, and it is mainly due to this fact that the rainfall of Lincolnshire can be treated in such detail. Private observers belonging to all classes in the community have also kept up observations, sometimes for long periods.

In Lincolnshire there are thus many long records of rainfall running through the whole period of thirty-five years, and these made it possible to calculate the relative wetness of each year compared with the average. Expressing the average at each station as 100 the relative wetness and dryness of any year can be readily recognised, no matter how different the mean rainfall at the various stations may be.

The stations for which ratios were calculated were grouped according to their geographical position as Northern, Southern, Eastern and Western. The mean ratio for each group is given in Table I., together with the average of the whole series. This average may be taken as an index to the fluctuations of rainfall for the county as a whole during the thirty-five years, 1868–1902. It is at once apparent that the first half of the period had a rainfall substantially above the average, while the second half had a rainfall on the whole below the average. The wettest year appears to have been 1880, with a rainfall 38 per cent. above the average, but in 1872 (the wettest year for the British Isles as a whole) the excess was 37 per cent.; and for 1882 it was 34 per cent.

The driest year, as in most parts of the country, was 1887, when the deficiency amounted to 35 per cent., while in 1874 and 1884 the deficiency was 27 per cent. The driest three consecutive years were 1887–89, which gave an average deficiency of 12 per cent.,

and the three years 1897–1899 were within one per cent. of being equally dry. This is an unusually small deficiency, as the deficiency for the three driest years usually amounts to 20 per cent.

In cases where the record extended over a period shorter than thirty-five years, the mean for the whole set of years available has been corrected by using the ratio-table so as to yield the computed mean value of the rainfall for thirty-five years. All the figures used in the construction of the Map have thus been reduced to a common period. There is reason to believe that the mean rainfall of any period of thirty-five years does not differ by more than about 2 per cent. from the mean of any other period of thirty-five years, and, therefore, for localities with a mean rainfall of about 26 inches, such a mean, if expressed only to the nearest half-inch, may be accepted as the true mean.

After being reduced to the same long period the rainfall values have been corrected for difference in the heights of the gauges above ground. This is particularly necessary in the case of Lincolnshire as almost all the gauges of the Great Central Railway are placed 3 feet 6 inches above the ground, while some old private gauges are as high as 6 or even 8 feet. The standard height for the receiving surface of a rain-gauge in the British Isles is 1 foot above the ground, and many experiments have proved that for every additional foot of height up to about 10 feet, there is a falling off of the catch of rain by about 1 per cent. The correction of 1 per cent. per foot above 1 foot has consequently been added, but no other correction has been applied to the figures.

There were altogether eighty-three stations in Lincolnshire, and on its borders, the records at which were sufficiently accurate and long-continued to justify their use in preparing the Map. From the data afforded by these stations, which were distributed over the county in a satisfactory way, lines were drawn including all places having a rainfall below 22·5 inches, and above 25·0 inches, 27·5 inches and 30 inches respectively. These lines as reproduced on a small scale map give as accurate a representation of the distribution of rainfall in the county as it is possible to obtain from existing records.

The following table shows the area occupied by each zone of 2½ inches of rainfall, and the mean rainfall of the zone :—

Zone.	Square Miles.	Per cent. of total area.	Mean Rainfall of Zone.
Below 22·5 in. - -	34	1·3	22·25
22·5 to 25·0 in. - -	1409	53·6	24·00
25·0 „ 27·5 „ - -	898	34·2	26·00
27·5 „ 30·0 „ - -	236	9·0	28·50
Above 30 in. - - -	51	1·9	30·25
Total - -	2628	100·0	

From these values the mean rainfall for the whole county is found to be 25¼ inches, and applying the mean ratios for various years from Table I. we get :—

1868–1902.	Mean average Rainfall for Lincolnshire - -	25·25 in.
1880 and 1872.	Maximum average Rainfall for Lincolnshire -	34·70 ,,
1887.	Minimum average Rainfall for Lincolnshire -	16·40 ,,
1887–1889 and 1897-99.	Driest 3 years' average Rainfall for Lincolnshire -	22·20 ,,

Broadly speaking, the county falls into three divisions as regards rainfall : a dry strip running through the centre from south to north, a wetter belt to the west running from south to north along the Oolitic escarpment, and a still wetter area on the east occupying the whole of the Chalk Wolds.

The dry central belt may include a narrow strip of 22·5 inches, or scarcely more, running from near Woodhall Spa in a winding path to the southern boundary, but the observations available do not justify us in showing it farther south than the railway joining Sleaford and Boston. Although the rainfall of the central strip exceeds 25 inches in the north, it is only by half an inch or so, and right up to the Humber it remains somewhat lower than on the Lincoln Cliff to the west or on the Wolds to the east.

A break is shown in the belt exceeding 25 inches near Grantham, but the rainfall in the gap does not appear to be less than 24·5 inches. The hilly ground to the south, however is distinctly wetter than the long narrow ridge of the Lincoln Cliff, to the west of which the flat valley of the Trent is markedly drier. It is probable that the gap in which part of Lincoln stands has a rainfall appreciably lower than 25 inches, but this is the case on so small an area that it is impossible to indicate it on a map of the scale employed.

The wettest part of Lincolnshire is undoubtedly on the Wolds, where the area with a mean rainfall exceeding 27·5 inches, measures 28 miles from south to north, and 11 miles from west to east, and includes almost all the ground which exceeds 100 feet in elevation. Immediately to the west of Louth the rainfall slightly exceeds 30 inches, and this must be the case over an area measuring 11 miles by 5 at least. Possibly the area should be extended 4 miles or so to the north-east, but as no part of it appears to have a fall exceeding 31 inches, it seemed safer not to exaggerate its importance by drawing the line any farther than the available figures absolutely warranted. Probably no part of the Wolds more than 400 feet above sea-level has a rainfall appreciably less than 30 inches.

It must be remembered in studying the isohyetal lines of Lincolnshire that the whole range of rainfall between one place and another is extremely small, not more than 8 inches, and that consequently, it is rarely possible to draw the lines with any certainty that they might not be equally accurate a mile on one side or on the other of the position they occupy.

As the stations from which the map was compiled are sometimes so close together that it is necessary to take the mean of several in order to obtain the figure for the spot in question, and as a few short records were taken to fill wide gaps between long-established stations, it is unnecessary to print all the values which have been utilised. Table II., however, gives particulars of a selection of typical stations including the wettest and the driest.

The importance of the rainfall of Lincoln as a source of underground water is enhanced by the fact that the lower ground on which the rainfall is least, is usually covered with impermeable clays, while the higher land, on which the amount of rainfall increases in close sympathy with the altitude, contains outcrops of the eminently permeable Oolitic strata and Chalk.

It is well known that the absorption of rain by the rocks depends to a considerable extent, upon the season. In summer, when evaporation is at a maximum and plant-life is making its greatest demands on the rain as it falls, there is practically no absorption, hence it is important to ascertain the seasonal incidence of the rain.

Table III. gives the mean monthly rainfall for thirty-five years, or nearly so, at six typical stations representing all parts of the county. The figures are not corrected for the height of the rain-gauge above ground; but a supplementary table gives the monthly falls expressed as a percentage of the annual total, and these values may be taken as correct.

It is seen that in almost all stations the month of highest rainfall is October, the only exception being July in one instance; but the column of maximum monthly rainfall shows how frequently very heavy falls occurred in all the summer months as the result of thunderstorms. The lowest monthly rainfall occurred in March or April in all cases. The monthly values expressed as percentages of the annual fall, give the clearest view, and the average percentages in the last column may be taken as a very close approximation to the monthly incidence of rain over the county.

It will be noticed that the stations on the Wolds have the greatest percentage of winter rain, those in the Fen the greatest percentage of summer rain.

(*See Map at end of vol.*)

TABLE I.

RAINFALL OF LINCOLNSHIRE.

RATIO OF EACH YEAR TO THE AVERAGE, 1868 TO 1902.

Years.	Northern Division.	Southern Division.	Eastern Division.	Western Division.	Mean for Lincolnshire.
1868	101	101	97	95	99
1869	108	111	112	110	110
1870	101	75	75	77	82
1871	106	99	97	98	100
1872	131	142	134	141	137
1873	87	88	81	81	84
1874	73	77	72	72	73
1875	106	126	120	111	116
1876	112	128	125	121	122
1877	109	106	104	113	108
1878	110	107	112	108	109
1879	105	109	109	105	107
1880	127	144	145	137	138
1881	103	111	110	102	106
1882	138	128	129	139	134
1883	121	127	135	126	127
1884	72	75	72	72	73
1885	105	102	101	104	103
1886	103	118	117	115	113
1887	65	64	64	69	65
1888	95	89	93	93	93
1889	101	103	102	114	105
1890	78	78	73	85	78
1891	107	102	105	110	106
1892	102	95	97	94	97
1893	76	74	77	78	76
1894	103	92	92	91	95
1895	104	88	92	95	95
1896	101	92	94	94	95
1897	97	93	96	93	95
1898	86	81	82	77	81
1899	90	87	86	88	88
1900	108	110	117	111	112
1901	91	87	91	90	90
1902	79	91	92	91	88

TABLE II.

MEAN ANNUAL RAINFALL OF LINCOLNSHIRE.

Station. The Nos. in brackets refer to the new series one-inch Ordnance Survey Sheets.	Height above.		Period of Observation.	No. of Years.	Arithmetical Mean.	Computed True Mean 35 years.	True Mean corrected for height of gauge above ground.
	Ground.	Sea Level.					
	ft. in.	ft.			in.	in.	in.
Bourn, Witham on the Hill [143]	4·3	—	1828—1862	35	23·71	23·7	24·4
Spalding, Pode Hole [144]	1·0	20	1868—1902	35	24·31	24·3	24·3
Grantham, Stainby [143]	0·9	496	1889—1902	14	23·87	25·5	25·5
„ [114]	0·6	179	1868—1880	13	25·25	24·0	24·0
Boston, Grand Sluice [128]	8·0	18	1868—1902	35	23·20	23·2	24·8
Sleaford, Rauceby Hall [127]	1·0	125	1892—1902	11	23·65	26·0	26·0
Leake, Lade Bank [115]	1·0	10	1883—1902	20	21·78	23·2	23·2
Stubton [127]	4·6	94	1868—1902	35	24·71	24·7	25·6
Sleaford, Bloxholm [127]	1·6	20	1875—1902	28	24·58	24·4	24·4
Navenby [114]	1·2	215	1869—1892, 1900—1902	27	25·71	24·9	24·9
Kirkstead [115]	1·2	—	1889—1902	14	20·78	22·3	22·3
Skegness [116]	1·6	20	1881, 1883–86, 1888–89, 1891–92 1896–99, 1901	14	23·21	23·5	23·5
Revesby [115]	0·6 / 2·0	135	1868—1902	35	24·76	24·8	24·8
Lincoln, St. Botolph's [114]	1·3	25	1868—1902	35	24·29	24·3	24·3
„ Doddington [114]	1·2	92	1872—1902	31	23·85	23·7	23·7
Horncastle, Hemingby [103]	1·0	158	1881—1902	22	26·45	27·5	27·5
Alford [104]	1·0	29	1884—1902	19	23·08	25·2	25·2
Farforth, Maidenwell House [103]	1·0	380	1888—1900	13	28·19	30·4	30·4
Gate Burton [102]	3·6	96	1868—1902	35	23·65	23·6	24·2
Louth [103]	6·0	111	1868—1902	35	28·83	28·8	30·2
Market Rasen [102]	0·8	84	1886—1902	17	24·63	26·4	26·4
Stockwith [88]	3·6	21	1868—1902	35	23·02	23·0	23·6
North Thoresby [90]	1·0	46	1892—1901	10	24·11	25·6	25·6
Caistor [89]	1·2	283	1876–98, 1900–02	26	26·78	26·8	26·8
Grimsby, Aylesby [90]	1·6	—	1873—1893	21	26·37	26·4	26·4
Barnetby [89]	3·6	51	1868—1902	35	24·78	24·8	25·4
North Level Engine [*Thorne*] [79]	2·3	—	1881—1902	22	21·90	22·6	22·8
Appleby [86]	0·9	60	1868—1890	23	26·00	25·4	25·4
Killingholme [81]	1·4	60	1868—1885	18	28·23	26·5	26·5
New Holland [80]	3·6	18	1868—1902	35	22·58	22·6	23·1

TABLE III.

MONTHLY RAINFALL IN LINCOLNSHIRE 1868 TO 1902.

Months.	Spalding, Pode Hole.					Stubton.					Revesby.					Lincoln, St. Botolph's (1870 to 1902).				
	Mean Monthly Fall.	Maximum Fall.	Date.	Minimum Fall.	Date.	Mean Monthly Fall.	Maximum Fall.	Date.	Minimum Fall.	Date.	Mean Monthly Fall.	Maximum Fall.	Date.	Minimum Fall.	Date.	Mean Monthly Fall.	Maximum Fall.	Date.	Minimum Fall.	Date.
	in.	in.		in.		in.	in.		in.		in.	in.		in.		in.	in.		in.	
January	1·66	3·37	1900	·25	1880	1·69	3·14	1886	·24	1880	1·72	3·79	1895	·38	1880	1·66	3·30	1895	·18	1880
February	1·63	5·25	1900	·00	1891	1·70	4·26	1881	·09	1891	1·71	4·14	1900	·11	1891	1·64	3·58	1900	·06	1891
March	1·35	2·83	1869	·37	1893	1·47	3·18	1888	·27	1893	1·39	2·68	1886	·23	1900	1·44	2·95	1889	·34	1893
April	1·77	6·38	1876	·13	1893	1·75	3·73	1872	·10	1893	1·63	3·71	1876	·11	1893	1·66	3·22	1872 1882	·30	1893
May	1·92	5·50	1889	·50	1868 1881	2·13	5·87	1889	·20	1868	1·77	5·04	1869	·35	1868	1·87	4·76	1886	·57	1888
June	1·94	5·50	1880	·25	1901	2·04	4·18	1883	·34	1868	1·92	4·41	1883	·19	1887	2·21	6·67	1883	·31	1887
July	2·62	9·09	1875	·25	1885	2·31	5·82	1880	·21	1885	2·25	5·94	1880	·49	1868	2·40	5·81	1888	·28	1885
August	2·43	6·75	1878	·75	1883	2·43	6·04	1878	·40	1871	2·48	5·97	1878	·49	1899	2·53	7·31	1878	·64	1899
September	2·22	6·25	1883	·25	1890	2·12	4·90	1883	·34	1898	2·29	7·00	1883	·25	1898	2·02	4·49	1883	·46	1898
October	2·49	5·75	1880	·08	1888	2·68	5·72	1880	·56	1888	2·95	6·72	1875	·48	1888	2·67	5·89	1885	·51	1897
November	2·12	4·50	1875	·63	1889	2·11	3·94	1875	·66	1889	2·27	5·96	1875	·44	1889	2·16	4·11	1875	·72	1889
December	2·16	6·50	1868	·38	1873	2·28	5·74	1868	·26	1873	2·38	5·40	1901	·29	1873	2·08	4·81	1876	·15	1873
Year	24·31	37·12	1880	15·13	1887	24·71	36·49	1872	17·56	1893	24·76	34·73	1883	17·06	1890	24·34	35·16	1872	16·76	1874

TABLE III.—*continued.*

MONTHLY RAINFALL IN LINCOLNSHIRE 1868 TO 1902—*continued.*

Months.	Louth.					Barnetby.					Mean Monthly Fall expressed as percentage of Annual Mean.						
	Mean Monthly Fall.	Maximum Fall.	Date.	Minimum Fall.	Date.	Mean Monthly Fall.	Maximum Fall.	Date.	Minimum Fall.	Date.	Spalding.	Stubton.	Revesby.	Lincoln.	Louth.	Barnetby.	Mean.
	in.	in.		in.		in.	in.		in.								
January	2·08	5·12	1895	·15	1880	1·52	3·13	1886	·08	1880	6·8	6·8	6·9	6·8	7·2	6·2	6·8
February	1·98	4·15	1900	·08	1891	1·64	4·16	1883	·10	1891	6·7	6·9	6·9	6·7	6·9	6·6	6·8
March	1·88	3·17	1889	·48	1900	1·51	3·52	1876	·36	1900	5·6	6·0	5·6	5·9	6·5	6·1	5·9
April	1·80	3·30	1877	·20	1893	1·59	4·12	1882	·19	1893	7·3	7·1	6·6	6·8	6·2	6·4	6·7
May	2·10	6·34	1869	·38	1868	1·84	5·60	1886	·46	1884	7·9	8·6	7·2	7·7	7·3	7·4	7·7
June	2·27	5·31	1892	·12	1887	1·98	4·65	1882	·00	1887	8·0	8·3	7·8	9·1	7·9	8·0	8·2
July	2·59	6·45	1888	·59	1870	2·27	6·40	1888	·11	1897	10·8	9·4	9·1	9·9	9·0	9·2	9·6
August	2·75	5·52	1878	·18	1899	2·68	8·26	1878	·63	1899	10·0	9·8	10·0	10·4	9·5	10·8	10·1
September	2·66	5·59	1896	·26	1898	2·16	5·17	1871	·10	1902	9·1	8·6	9·2	8·3	9·2	8·7	8·8
October.	·28	6·77	1870	·73	1897	3·00	8·03	1870	·85	1879	10·2	10·8	11·9	11·0	11·4	12·1	11·2
November	2·67	5·83	1875	1·12	1873	2·28	4·62	1875	·29	1902	8·7	8·5	9·2	8·9	9·3	9·2	9·0
December	2·77	6·82	1868	·27	1873	2·31	6·21	1901	·51	1890	8·9	9·2	9·6	8·5	9·6	9·3	9·2
Year.	28·83	41·37	1872	20·89	1884	24·78	36·91	1882	15·40	1887	100	100	100	100	100	100	100

WELL SINKINGS AND BORINGS IN LINCOLNSHIRE.

[The groupings of Strata have been added by Mr. A. J. Jukes-Browne, Mr. H. Preston, Mr. C. Reid, Mr. A. Strahan, Mr. C. Fox-Strangways, Mr. W. A. E. Ussher, Mr. W. Whitaker, or Mr. H. B. Woodward.]

Note.—The Maps referred to are (1) the old series Geological Survey Maps, (2) the new series one-inch Ordnance Survey Maps, and (3) the Ordnance Survey six-inch maps.

Aby.

(1 in. Map 84, N.S., 103; 6 in. Map 66 N.W.)

Well at the blacksmith's house.

Information obtained on the spot.

		Ft.
	Dug through [Drift] clay into gravel	26

Alford.

(1 in. Map 84, N.S., 104; 6 in. Map 66 S.E.)

1. Well at Mr. Soulby's brewery, yielding a good supply of water. Communicated by Messrs. Baker & Son.

		Ft.	in.
Glacial Drift.	Gravel	8	6
	Clay [Boulder Clay]	20	6
	Black rock [? a boulder]	0	6
	Black pebbles	2	0
	Red rock [a boulder]	0	4
	Pebbles	1	6
	Ironstone [a stone]	0	2
	Pebbles	2	6
	White rock [a boulder]	0	6
	Silt	2	0
Chalk and Clays	Chalk rock	26	8
	Shingle	—	
	Sand	—	

No record was kept of the beds lying below the Chalk, but if clay was found immediately below, this is probably Boulder Clay, and the Chalk must be a large mass included in the Glacial deposits. The succession may then be summarised as follows:—

		Ft.	in.
	Gravel	8	6
	Boulder Clay	20	6
	Gravel, with large stones and fragments of rock	7	6
	Silt	2	0
	Chalk (an included mass)	26	8
	Boulder Clay perhaps	10	0
	Sand and shingle perhaps	3	0
	About	78	0

A.J. J.B,

2. At Mr. Lewis' house S.W. of the Church.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

		Ft.
Glacial Drift.	Sandy gravel	8
	Stiff clay	22
	Sand and water	6
	Marly clay	15
Chalk		22
		73

3. In the new road about two furlongs S.W. of the Church.

Communicated by Mr. J. Bingley.

		Ft.
Glacial Drift.	Gravel	24
	Clay	12
	Sand	18
Chalk rock		12
		66

Another well in Chapel Street N.W. of the Church is only 42 feet deep, through clay into gravel with water.

4. Well at a new house in the south part of the town.

Communicated by Mr. J. Bingley.

		Ft.
Glacial Drift.	Small gravel and sand	20
	Marl	9
	Gravel	12
Hard Chalk		9
		50

The surface of the Chalk here is at nearly the same depth as in Mr. Soulby's well; it may, therefore, be part of the same mass.

5. At the new Grammar School, made in 1880.

Dug 20 feet, bored 18 feet.

	Ft.
Through dark purple-brown Boulder Clay, into loose gravel with water	38

6. At Grammar School.

Communicated by Mr. Eardley Mason to Mr. A. J. Jukes-Browne, 1889, *Quart. Journ. Geol. Soc.*, vol. xlix., p. 469.

	——	Thickness.	Depth.
		Ft. in.	Ft. in.
Glacial Deposits	Brown Boulder Clay	30 0	30 0
	Gravel	10 0	40 0
	Brown Boulder Clay	2 0	42 0
	Gravel	6 0	48 0
	Boulder Clay	6 0	54 0
	Chalk, part white, part reddish	10 0	64 0
	Gravel	5 0	69 0
	Red clay, partly Boulder Clay, partly reddish marl with quartz-grains	11 0	80 0
Lower Cretaceous	Coarse greenish-brown sand (Carstone)	12 0	92 0
	Blue clay	2 0	94 0
	Light-grey clay	6 0	100 0
	Blackish clay, with oolitic grains	5 4	105 4
	Dark, greenish, silty clay, with oolitic grains	7 2	112 6

Water occurred (1) in the Chalk, (2) in the gravel beneath, and (3) in the greenish silty clay. The bore was plugged with clay to the base of the mass of Chalk, and this yielded a satisfactory and sufficient, though not abundant, supply. The Chalk is a large boulder or transported mass.

Allington.

(1 in. Map 70, N.S., 127 ; 6 in. Map 113, N.W.)
Allington Hall.
Made and communicated by Messrs. Le Grand and Sutcliff (1877).

	——	Thickness.	Depth.
		Ft. in.	Ft. in.
Dug pit (the rest bored)		—	3 6
Lower Lias	Dark blue clay	23 0	26 6
	Blue clay	45 0	71 6
	Dry blue clay	12 0	83 6
	Blue shale and rock	2 6	86 0
	Blue rock	4 6	90 6
	Black shale and rock	21 6	112 0
	Black rock	3 6	115 6
	Blue stone and shale	28 0	143 6
	Black shale	4 0	147 6
	Black shale and blue rock	8 3	155 9
	Black shale	4 9	160 6
	Black shale and rock	14 0	174 6
	Blue stone	2 6	177 0
	Blue stone and shale	4 0	181 0

Althorpe.

(1 in. Map 86, N.S., 88; 6 in. Map 18, N.W.)

1. Water taken partly from river Trent and partly from shallow wells in Alluvium.

2. Althorpe Wells, old name Aletorp.

Communicated by Mr. A. C. G. Cameron.

	Ft.
Warp	8 to 10
Sand	2
Warp.	

Amcotts.

(1 in. Map 86, N.S., 80; 6 in. Map 10, S.W.)

Water from shallow wells in Alluvium.

Anderby.

(1 in. Map 84, N.S., 104; 6 in. Map 67 S.W.)

1. At the Rectory (Mr. Bond's).

Communicated by Mr. Th. Newton, of Anderby (well-sinker).
Dug 12 feet, bored 80 feet.

	Ft.
Marl (Boulder Clay)	68
Sand	9
Chalk	15
	92

2. At Mr. W. Budibent's Farm.

Communicated by Mr. Th. Newton, of Anderby (well-sinker).
Dug 9 feet, bored 86 feet.

	Ft
Marl (Boulder Clay)	71
Sand	10
Chalk	14
	95

3. At Mr. Robinson's Farm, west of Anderby Creek.

Communicated by Mr. Th. Newton, of Anderby.

		Ft.
Post-Glacial	Buttery clay	20
	Sand and gravel	4
Glacial	Hard marl (Boulder Clay)	52
	Sand and chalk rubble	10
	Solid Chalk rock	12
		98

Appleby.

(1 in. Map 86, N.S., 80; 6 in. Map 11 S.W.)

The following borings, 1 to 4, were communicated by Mr. A. Atkinson; they were also furnished to Mr. Fox-Strangways by the Rev. J. E. Cross, with others, which are given farther on. Bore 3 is in the Oolitic area, south of

Appleby Station, and as its site, Spring Wood Lodge, is shown on the Ordnance Map (86), the positions of the other three borings are indicated with reference to it. The correlations are by Mr. Ussher; from the Northampton Beds (Dogger) downward they are tolerably certain.

1. Two miles due west of Bore 3.

		Ft.	in.
Sand		1	4
Ironstone (Frodingham rock)		18	5
		19	9

2. One mile and 2 or 3 chains due west of Bore 3.

		Ft.	in.
Sand		3	0
Lower Lias	Blue Shale	78	0
	Ironstone	30	0
	Blue Shale	5	0
		116	0

3. At Spring Wood Lodge.

			Ft.	in.
Lincolnshire Limestone	Gravel (rubbly oolitic limestone) and sand*		18	0
	Red sand (possibly Lower Estuarine)		10	4
Probably Lower Estuarine		Blue shale	24	0
Northampton Beds		Stone, very hard	1	3
Upper Lias		Dark blue shale	37	6
Middle Lias	Marlstone Rock Bed	Sandstone	5	4
	Clay	Blue shale	68	2
	Pecten bed	Ironstone top bed	4	2
Lower Lias	Clay	Blue Lias shale	89	9
	Frodingham Ironstone	Ironstone bottom bed	24	3
			282	9

4. One mile and 54 chains north of Bore 3.

			Ft.	in.
Lincolnshire Limestone		Limestone	36	8
Probably in part Lower Estuarine		Blue shale	34	4
Northampton Beds		Sandstone	1	11
Upper Lias		Grey shale	25	10
Middle Lias	Marlstone Rock Bed	Sandstone	7	10
	Clay	Shale, with cement nodules	67	6
	Pecten bed	Ironstone top bed	4	2
Lower Lias	Clay	Blue Lias shale	89	9
	Frodingham Ironstone.	Ironstone bottom bed	24	3
			292	3

* There are no surface-deposits.

5. Borings at Haverholme Plantation.

A.—5½ furlongs due N. of Spring Wood Bore.

			Ft.	in.
Drift	Sand		7	0
Lincolnshire Limestone	Limestone		40	6
? Lr. Estuarine Shale	Shale		7	0
? Northampton Beds	Limestone		4	4
? Upper Lias	Shale		15	6
Middle Lias	Limestone		6	7
	Blue shale		60	5
	Ironstone		3	5
	Blue shale.			
			144	9

B.—7 furlongs due N. of Spring Wood Bore.

		Ft.	in.
Cornbrash limestone		4	0
Sandstone, Shale, White sand, Clays	Great Oolite Series etc.	78	9
Limestone (Lincolnshire Limestone not bored through)		43	3
		126	0

In Boring B, the beds under the Cornbrash are evidently given in so generalised a way that no correlation of Great Oolite Clays and Hibaldstow Beds could be attempted. The 60 feet of "Blue shale," in Bore A, appears to be Middle Lias, and the shale 15 feet 6 inches thick may be the sole representative of the Upper Lias.

6. Detailed account of the South Shaft, Appleby.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift 10 ft. 2 in.	Earth	0	8		
	Yellow sand	4	6		
	Grey sand	2	0		
	Gravel	2	0		
	Grey sand	1	0	10	2
Lincolnshire Limestone	Blue clay	1	0		
	Gravel [broken stone]	2	0		
	Blue clay	2	0		
	Gravel [broken stone]	2	0	17	2
	Limestone	2	6		
	Blue bind	0	6		
	Blue limestone	1	0		
	Blue bind	0	10		
	Strong blue limestone	2	6		
	Strong bind	1	6		
	Blue bind	0	6		
	Strong blue limestone	2	6	29	0
	Strong bind	3	0		
	Blue bind	5	0		
	Strong bind	3	0		
	Stone	4	6		
	Blue bind	0	6	45	0
	Strong blue limestone	4	6		
	Clay parting	0	2		
	Strong blue limestone	2	0	51	8
? Lower Estuarine and Northampton Beds	Stone bind	4	8		
	Blue bind	6	0	52	4
	Ironstone	1	[illegible]		
	Sandstone with iron ore	3	0	66	5

Detailed Account of the South Shaft, Appleby—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Blue bind	12 0	
	Blue bind	17 0	
? Upper Lias	Strong blue limestone	1 0	
	Blue bind	38 0	
	Strong bind	1 4	135 9
? Marlstone Rock Bed	Strong stone	5 6	
	Stone mixed with sulphur and coprolites	1 6	142 9
		142 9	

7. Detailed account of the North Shaft, Appleby.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Earth	0 9	
	Limestone gravel	7 0	
	Yellow limestone	4 3	
	Blue limestone	4 0	
	Strong blue limestone	3 0	
Lincolnshire Limestone.	Clay parting	0 2	
	Strong blue limestone	3 0	
	Blue bind	0 9	
	Strong blue limestone	3 3	
	Strong blue bind	2 0	
	Stone bind	2 8	30 10
	Blue bind	6 0	
	Yellow bind	1 6	38 4
? Lower Estuarine series, etc.	Blue bind	27 0	
	Blue limestone	1 0	
	Blue bind	2 0	
	Strong bind	3 0	71 4
? All Upper Lias.	Blue bind	54 0	125 4
Middle Lias — Marlstone Rock Bed.	Strong stone	5 6	
	Stone mixed with coprolites and sulphur (pyrites)	1 6	132 4
	Blue bind	63 0	195 4
	Ironstone (Pecten Bed)	4 10	200 2
	Blue bind	93 0	293 2
Lower Lias.	Top of ironstone (Scunthorpe low bed).		

Mr. Strangways furnishes the following notes :—

Nine sections (boreholes and shafts) nearly in a straight line between the Keeper's Lodge at Spring Wood and Appleby, were made by Mr. Winn to prove

the depth and nature of the Lias Ironstones. These sections, although tolerably clear for the divisions of the Lias, are not so for the Oolites above, probably from the fact of the very shaly character of much of the limestone which in these accounts seems to have been frequently entered under the name of "bind."

Asgarby (Sleaford).

(1 in. Map 70, N.S. 127 ; 6 in. Map 106 N.E.)

Boring on estate of the Marquis of Bristol, 1900.

Communicated in part by Messrs. Hamnett & Co.

Passed through 6 inches of sand at depth of 147 feet. Water "very salt" rose within 30 ft. of surface; a little more water met with at 201 ft. and again at 280 ft.

		Thickness.	Depth.
		Ft.	Ft.
Glacial Drift.	Soil	1	1
	Sand and gravel	6	7
Oxford Clay and Kellaways Beds.	Blue clay	168	175
	Blue rock	6	181
	Blue clay	2	183
	Black rock	13	196
	Blue clay	4	200
Cornbrash.	Hard blue rock	12	212
Great Oolite Clay.	Blue clay	18	230
Great Oolite Limestone.	Blue rock	18	248
Upper Estuarine Series.	Blue clay	4	252
	Hard blue rock and clay mixed in 2 in. and 3 in. layers	6	258
	Hard black silt	14	272
Lincolnshire Limestone.	Rock	15	287
	Blue clay	2	289
	Very hard rock	4	293
	Softer rock		

An ammonite coated with pyrites was found at the depth of 192 ft.

Ashby-cum-Fenby.

(1 in. Map 86, N.S. 90 ; 6 in. Map 30 S.W.)

½-mile N.W. of the Church.

Communicated by Mr. Westaby.

		Ft.
Boulder Clay. Chalk.	Clay with chalk stones	120

The surface is about 30 ft. above the stream. Water rises to within 30ft. of the surface.

Aslackby.

(1 in. Map 70, N.S. 143 ; 6 in. Map 124 S.E.)

1. Boring at Graby to depth of 150 ft. No water.

J. Addy, *Proc. Inst. C.E.*, lxxiv. (1883), 160.

2. Boring at the "Red Lion," made by Mr. J. E. Noble, Thurlby, in 1903.

Communicated by Mr Henry Preston.

A plentiful supply. Water level 60 feet below ground surface.

———		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	1	6	1	6
Drift and Alluvium.	Sand	6	6	8	0
	Clay	2	6	10	6
	Hard sand	7	6	18	0
	Clay	5	0	23	0
Cornbrash.	Hard rock	4	2	27	2
Great Oolite Clay.	Clay	22	10	50	0
Great Oolite Limestone.	Rock	9	8	59	8
Upper Estuarine Series.	Clay	12	0	71	8
	Rock	5	0	76	8
	Grey marl	18	4	95	0
Lincolnshire Limestone.	Limestone	70	0	165	0

(1 in. Map 70, N.S. 144; 6 in. Map 125 S.W.)

3. Aslackby Fen. Boring 5 miles east of the village, near the South Drain. Made by Mr. Noble of Thurlby in 1901. Height above O.D., 10 ft.

Communicated by Mr. Henry Preston.

There is a good supply of water.

———		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	1	0	1	0
Fen Beds.	Clay	5	0	6	0
	Clay and gravel	7	0	13	0
Oxford Clay and Kellaways Beds.	Clay	40	6	53	6
	Hard sand	8	0	61	6
	Clay	12	6	74	0
Cornbrash.	Rock	4	6	78	6
Great Oolite Clay.	Clay	22	6	101	0
Great Oolite Limestone.	Rock	11	0	112	0
Upper Estuarine Series.	Clay	26	0	138	0
	Grey marl	14	0	152	0
Lincolnshire Limestone.	Rock	10	7	162	7

Aswarby.

(1 in. Map 70, N.S., 127; 6 in. Map 115 N.W.)

1. Barrow Hill Farm on the N. side of Aswarby Park.

Information obtained by W. H. Holloway.

		Ft.
Kellaways sands and clay	about	18
Cornbrash		15
Great Oolite Clay. — Soft buttery clay		5
Great Oolite Clay. — Stone		2
Great Oolite Clay. — Clay		20
		60

Bored 60 feet further. No information obtained.

2. Well at the Lodge of Aswarby Hall is sunk 14 feet through sandy and claycy beds, with occasional hard bands belonging to the Kellaways Beds.

3. "Tally-ho," Aswarby.

Information obtained by W. H. Holloway from workmen.

	Ft.
Soil	2
Blue clay	6
Rock (? Cornbrash)	3
	11

4. A boring at Aswarby made in 1886 by Mr. Jesse Clare was carried to a depth of 131 feet, into the Lincolnshire Limestone, and water rose above surface during part of year.

5. Mansion of Sir George Whichcote, Bart. 1904.

Communicated by Messrs. Barnes and Sharpe, Sleaford.

Water rose above surface 8 ft. but subsequently settled at ground level. Supply 6,000 gallons per hour of very good water.

		Thickness.	Depth.
		Ft.	Ft.
	Soil	3	3
Oxford Clay.	Clay	7	10
Cornbrash ?	Sandstone	10	20
Great Oolite Clay?	Rock	3	23
	Clay	3	26
	Sandstone	4	30
Great Oolite Limestone.	Rock	24	54
Upper Estuarine Series.	Clay	12	66
	Rock	1	67
	Clay	8	75
	Rock	3	78
	Clay	16	94
Lincolnshire Limestone.	Oolite	76½	170½

Authorpe.

(1 in. Map, 84, N.S., 103 ; 6 in. Map 56 S.E.).

At the brickyard three furlongs N.N.E. of Church.

Information from Mr. Turner (proprietor).

		Ft
Glacial Drift.	Loamy soil	2
	Reddish-brown clay	8
	Purple loamy clay	5
	Purple clay, with stones	9
	White marl, with stones	5
	Sandy gravel	2
	[? Clay and] yellowish sand	30
	Chalk rock, touched	—
		61

Bardney.

(1 in. Map 83, N.S., 115 ; 6 in. Map, 72, S.W.)

Hare Booth, three-quarters of a mile south-east of Southrey Station.

Information obtained from the occupier (Mr. Wright).

	Ft.	in.
Black soil ("warp")	0	10
Turfy layer, full of wood	2	0
Silty clay, "mild and buttery"	3	0
Gravel, with water at bottom	5	0
Bluish clay, "stiff" (?Boulder Clay)	6	0
Quicksand and water	0	2
	17	0

See also Analyses, p. 199.

Barkstone.

(1 in. Map 70, N.S., 127 ; 6 in. Map 104 S.E.)

1. Well for Westfield Farm, about 500 yards south-east of Barkstone Junction. 1901.

Communicated by Mr. H. Preston, from information obtained on the spot.

Height above O.D. about 155 feet. Yield, no water.

	——	Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Valley Gravel	Red soil	4	0		
	Thin, irregular beds of gravel, with iron stone concretions	1	6	5	6
Lower Lias	Blue clay	20	6	26	0
	Concretionary nodules	0	6	26	6
	Bed of crushed fossils (*Modiola*, *Pholadomya*, etc.)	1	0	27	6
	Blue clay	6	6	34	0

No water being obtained a "water-finder" was brought, and he indicated a spot 20 yards away to the south where a supply would be found at a depth of 17 or 18 feet. A well was sunk 24 feet to the nodule-bed, and a 2-inch boring for a further depth of 26 feet (total 50 feet), all in blue clay. No water obtained.

2. Well at Barkstone Heath, in Farmyard.

(6in. Map 114 N.W.)

Made by Mr. Frank Hobson (well sinker).

Communicated by Mr. H. Preston.

Yield, 6 feet water in well. A good supply.

	Ft.	in.
Lincolnshire limestone	40	0
Northampton sands	3	0
Lias clay	2	0
	45	0

Barrowby.

(1 in. Map 70, N.S., 127; 6 in. Map 113 S.W.)

Dr. H. F. Parsons (in a report to Local Goverment Board, 1890) remarks that there appears to be no difficulty in finding a supply of water in any part of the village. The wells are of moderate depth, usually 30 feet or under, and water rises in them to from 3 to 15 feet from the surface. The strata pierced by the wells, include (1) below the top soil, rubbly calcareous sandstone, locally called "skerry"; (2) clay or shale with one or two bands of ironstone; (3) grey rubbly rock, in which the largest and best supply of water is found.

1. Casthorpe Well.

Made by Mr. Frank Hobson (well sinker). 1892.

Communicated by Mr. H. Preston, from measurements.

Height above O.D. 352. Yield 1,000 gallons per twenty-four hours.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Middle Lias.	Red marl	5	0		
	Brown clay	9	0	14	0
	Ironstone concretions	0	3	14	3
	Brown clay	3	9	18	0
	Ironstone concretions	0	6	18	6
	Micaceous blue clay	11	6	30	0
	A Rock bed, iron-stained and concretionary	0	10	30	10
	Blue clay	10	0	40	10
	Large flat limestone concretions	0	4	41	2

Water comes into the well on the north-west side at Bed A. This bed is the usual source of supply in Barrowby. The well was tested by Mr. Preston during August, 1901, as a probable source for village-supply. The well had been standing unused for several years, and the water level was 18 feet from the surface. The daily yield decreased as the water was lowered, until after passing the water-bearing rock (Bed A.) not more than 1,000 gallons per diem could be obtained.

2. Barrowby Mires, 1 mile S.W. of Grantham.
(1 in. Map, N.S., 127 ; 6 in. Map, 113 S.E.)
Well in field ¼ mile N.E. of B. M.

		Ft.
Middle Lias.	Marlstone rock	27
	Bluish clay	3
		30

Barrow-upon-Humber.

(1 in. Map 86, N.S., 80 ; 6-in. Map 7 S.E.)
Communicated by Mr. Westaby.

1. At Mr. Westaby's house.

	Ft.
Clay and stones	15
Gravel	6
Clay	8
Gravel	13
To Chalk	42

2. Market Place.

	Ft.
Clay	9
Gravel	12
Clay	21
Gravel	15
To Chalk	57

3. Barrow Beck.

	Ft.
Loam	4
Gravel	2
Sand	1
Gravel	2
Clean clay	3
Gravel	13
	25

4. On the Goxhill Road, about ¾ mile [illegible] Barrow.

	Ft.
Clay	18
Sand	18
Clay	10
To Chalk	46

The bed of sand extends continuously for about a mile further east.

5. Barrow Ferry, E. side.

	Ft.
Warp : rock at	70

6. Barrow Ferry, W. side.

	Ft.
Warp : rock at	90

7. Farm 1 mile W. of Barrow Ferry.

	Ft.
Warp, etc.	78
Sand (rough)	12
To Chalk	90

8. New Holland.
(1 in. Map, N.S., 80; 6 in. Map 7 N.E.)
Communicated by Mr. Sampson to Mr. Penning.

	Ft.
Well, to Greensand [?]	320

9. Pier Head, New Holland.
Communicated by Mr. Westaby.

	Ft.
Warp	?
Hard clay with stones	30

Chalk (falls 3 feet from New Holland).

10. Jackson's Brick Yard, New Holland.
Communicated by Mr. J. Smalley.

	Ft.
To rock [Chalk]	46

11. Near the Railway Junction, New Holland.
Communicated by Mr. Westaby.

	Ft.
Brick clay (warp)	7
Warp	20
Peat with wood	2 to 4
Sand	3
Clean brown clay	about 17
To Chalk	50

12. New Holland to Barrow Ferry.
Communicated by Mr. Westaby.

For a mile the depth to the rock is about 50 feet, the top of the Chalk being very level.

Barton-upon-Humber.

(1 in Map 86, N.S., 80; 6 in. Map 7 N.W.)
Communicated by Mr. Westaby.

1. Newport.

	Ft.
Clay	21
Gravel	6
To Chalk	27

2. Lower end of Fleetgate.

	Ft.
Clay and stones	
Gravel about 3 feet	40
Clay	
Chalk	

3. Barton Water Side, several wells at the Brick Yards E. of, and at the Malt Kilns.

	Ft.
Warp - - - - - - - - - - - about	78
Sand (rough) - - - - - - - - - - -	12
To Chalk - - - - - - -	90

4. Barton Water Side, well 50 chains W. of.

	Ft.
Warp - - - - - - - - - - - about	70
Sand (rough) - - - - - - - - - - -	20
To Blackish or brown clay [Kimeridge ?], only touched - -	—
	90

Water was obtained from the sand.

5. Barton Water Side, well ¾ mile W. of.

	Ft.
Warp - - - - - - - - - - - -	70
Sand - - - - - - - - - - - -	20
To [Kimeridge Clay] Clay, black and hard.	—
	90

6. Bore-hole immediately within the Humber bank about ¾ mile east of Barton Water Side. Commences on the warp about 3 feet below high-water level.

	Ft.
Red clay - - - - - - - - - - - -	8½
Peat - - - - - - - - - - - -	3
Coarse sand - - - - - - - - - - -	20
Strong clay, small chalk stones [Boulder Clay] - - -	8
Soft warp - - - - - - - - - - - -	28
Strong fine clay - - - - - - - - - - -	5
	72½

7. N. side of the Ings Lane. Eight borings.

	Ft.
Warp, etc., to clay [Kimeridge] - - - - - -	90

8. Gas Works.

	Ft.
Warp with one or two sand beds - - - - - -	45
Chalk - - - - - - - - - - - -	15
	60

9. At the Ropery Engine House.

	Ft.
Warp and fine sand - - - - - - - - - -	50
Chalk - - - - - - - - - - - -	49
To Clay [Kimeridge] - - - - - - - - - -	—
	99

10. High Street.

	Ft.
Hard clay with chalk [Boulder Clay] - - - -	from 0 to 30
Chalk.	

11. At the junction of King Street and High Street, in a channel in the Chalk.

	Ft.
Clay and chalk [Boulder Clay]	30
Gravel	33
To Chalk	63

12. At the junction of King Street and Marsh Lane.

	Ft.
Clay and chalk [Boulder Clay]	36
Gravel	15
To Chalk	51

13. Whitecross Street.

Rock [Chalk] at the surface: 18 feet to water.

14. Well at the house W. of Mount Close.

	Ft.
Clay [Boulder Clay ?]	15
Chalk	

Baston.

1. Boring at Baston Fen, on Mr. Peasgood's Farm, 2 miles east of village. (1 in. Map, 64, N.S. 158; 6 in. Map 146 N.E.). 1896.

Made by Mr. J. E. Noble and communicated to Mr. H. Preston.

Height above O.D., 12; water overflows; yield, 4,000 per hour from a 2-inch boring.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil and Drift 12 ft.	Soil	4 0	—
	Gravel	8 0	12 0
Oxford Clay.	Clay	64 3	76 3
Cornbrash.	Rock	7 5	83 8
Great Oolite Clay 17 ft. 8 in.	Clay	13 0	96 8
	Rock	1 0	97 8
	Clay	3 8	101 4
Great Oolite Limestone 13 ft. 9 in.	Rock	10 0	111 4
	Clay	1 9	113 1
	Soft Rock	2 0	115 1
Upper Estuarine Series 27 ft. 6 in.	Clay	5 6	120 7
	Rock	1 0	121 7
	Clay	14 0	135 7
	Rock	4 0	139 7
	Clay	3 0	142 7
Lincolnshire Limestone	Rock to	28 0	170 7

2. Boring at Baston Fen, 5 miles south-east from Bourn.

Made and communicated by Mr. J. E. Noble. October, 1901.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift.	Soil	3	6	3	6
	Clay	3	6	7	0
	Gravel	6	6	13	6
Oxford Clay and Kellaways Beds	Clay	64	6	78	0
	Hard Sand	12	0	90	0
	Clay	7	0	97	0
Cornbrash	Rock	7	0	104	0
Great Oolite Clay	Clay	17	6	121	6
	Rock	0	6	122	0
	Clay	3	0	125	0
Great Oolite Limestone.	Rock	8	0	133	0
	Clay	3	0	136	0
	Rock	2	0	138	0
Upper Estuarine Series	Clay	19	0	157	0
	Marl	11	0	168	0
	Black Sand	2	0	170	0
Lincolnshire Limestone	Rock	9	2	179	2

Beesby.

(1 in. Map 84, N.S., 104; 6 in. Map 66, N.E.)

1. At Mr. Wakefield's house.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

	Ft.
Clay, with stones	34
Sand	3
Clay, with stones	35
Sand and gravel	3
Chalk	15
	90

2. At the Vicarage.

Communicated by Robert Harrison, of Woodthorpe (well-sinker).

	Ft.
Clay, with stones	63
Sand	9
Small chalk, mixed with sand	3
	75

Belton (Isle of Axholme).

(1 in. Map 86, N.S. 88; 6 in. Map 17 S.E.)

1. Tube well at North Moor, north-east of village.
Made by Mr. G. W. Thistlewood. 1893.
Communicated by Dr. R. Bruce Low in Report to Local Government Board, No. 70.
Yield, plentiful, somewhat chalybeate taste.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift	Red sand (with water: shut out by steel tubes to 39½ feet)	30	0	30	0
Keuper Marls	Red clay	4	0	34	0
	Gypsum	0	6	34	6
	Water stone, very dry	2	0	36	6
	Gypsum mixed in waterstone	2	0	38	6
	Gypsum mixed in light blue waterstone	3	6	42	0
	Red clay	1	0	43	0
	Water stone with 6 inches of gypsum, dry	4	0	47	0
	Red clay, very hard and dry	1	6	48	6
	Dark blue waterstone	4	0	52	6
	Gypsum in light blue stone, very dry	6	0	58	6
	Waterstone with gypsum beds mixed	3	6	62	0
	Very hard waterstone, very dry	7	0	69	0
	Very hard blue stone with water under, which yielded about 1½ gallons per minute	8	0	77	0
	Soft waterstone, no more water	4	6	81	6
	Waterstone, gypsum beds mixed	4	6	86	0
	Dark blue stone with 4 inches clay, dry	5	0	91	0
	Light blue stone, very hard and dry	6	6	97	6
	Gypsum, dry	1	6	99	0
	Waterstone and clay mixed, very dry	2	0	101	0
	Gypsum and waterstone, very dry	6	0	107	0
	Clay stone and gypsum mixed, dry	3	0	110	0
	Very hard blue stone (five and a half days going through this)	4	0	114	0
	Gypsum beds mixed in clay, very dry	2	0	116	0
	Blue waterstone, very hard	2	0	118	0
	Gypsum and dark red clay	2	0	120	0
	Waterstone	6	0	126	0
	Very hard blue stone	2	0	128	0
	Gypsum and marl	6	0	134	0
	Gypsum and marl with a little stone	6	0	140	0
	Very hard blue stone with more water	3	0	143	0
	Gypsum and marl, with a little waterstone	5	0	148	0

Belton was previously supplied with water from shallow wells.

2. Well at Sandtoft, near Crowle.
Sunk in 1876, by Hatfield Chase Commissioners.

Particulars given by Mr. E. C. B. Tudor, surveyor, Goole, to Dr. H. F. Parsons, *Proc. Yorksh. Geol. and Polyt. Soc.*, Ser. 2. vi. (1877), p. 230.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Alluvium and Drift.	Warp	3	0	3	0
	Fine red quicksand	25	0	28	0
	Red clay	6	0	34	0
	Coarse red sand	16	0	50	0
	Coarse red gravel (size of beans)	5	0	55	0
Keuper	White gritty sandstone	26	0	81	0

Belton (near Grantham).

(1 in Map 70 N.S., 127 ; 6 in Map 114 N.W.)

Belton Ashes, 3 miles north-east of Grantham. Mr. Lowe's Farm.

	Ft.
[Lincolnshire Oolite] Soil and limestone	8
[Northampton Sands] Red rock	15
[Upper Lias] Blue clay with nodules (sunk)	27
do. do. (bored)	40
	90

Benniworth.

(1 in. Map 83, N.S. 128 ; 6 in. Map 54 S.E.)

1. On the west side of the river Bain, near Donnington-on-Bain.
A boring by Messrs. E. and T. Bogg in search of coal.
Communicated by Edward Bogg, Land Surveyor, *Trans. Geol. Soc.*, vol. iii. (1816), pp. 395–398.

	Yds.	ft.	in.
1. A clay soil	1	0	0
2. Dark coloured clay	3	0	0
3. Soft grey slate with marine impressions	0	1	0
4. Blue argillaceous stone	0	0	5
5. Dark coloured clay	1	0	1
6. Soft grey slate same as No. 3	0	1	0
7. Laminated clay slightly indurated	7	2	0
8. Soft grey slate slightly inflammable	1	2	3
9. Same as No. 8, but darker coloured	1	2	3
10. Indurated clay with white marine organic remains	12	1	6
11. Same as last but harder and blacker	2	1	3
12. Dark bituminous inflammable schist	2	0	0
13. A dark blue coloured ironstone	0	0	3
14. Laminated indurated clay with white organic remains	11	0	0
15. Same as No. 14 but harder, with marine impressions of thin leafy pyrites	3	1	4
16. Dark blue argillaceous stone	0	0	4

	Yds.	ft.	in
17. Hard indurated laminated clay; with impressions consisting of thin leafy pyrites	6	0	4
18. Laminated bituminous schist, with white marine organic remains, and inflammable	0	1	10
19. Dark blue ironstone	0	0	2
20. Laminated bituminous schist, same as No. 18	3	2	0
21. Dark blue ironstone	0	0	1½
22. Laminated bituminous schist, same as Nos. 18 and 20	6	0	10½
23. Dark indurated clay, with some white marine organic remains	1	0	6
24. Laminated bituminous schist, same as Nos. 18 20 and 22	3	0	0
25. Dark indurated clay, same as No. 23	2	2	0
26. Laminated bituminous schist, same as Nos 18, 20, 22 and 24	1	1	6
27. Dark dry indurated clay, same as Nos. 23 and 25, intermixed with thin seams of laminated bituminous schist	10	0	3
28. Grit	0	0	2
29. Brown laminated schist	0	0	2
30. Hardstone bind or argillaceous stone	0	2	10
31. Hard laminated, bituminous schist	0	1	2
32. Hardstone bind, same as No. 30	0	2	0
33. Hard laminated bituminous inflammable schist	0	2	4
34. Inflammable slaty bind	1	0	0
35. Hard laminated bituminous schist, very inflammable	1	0	7½
36. Hard dark blue bind interlaid with thin strata of bituminous schist	4	1	9½
37. Very inflammable schist	0	0	2
38. Hard dark blue bind, same as No. 36	1	0	8
39. Argillaceous stone	0	1	0
40. Same as No. 39, but not so hard			
41. Hard dark blue bind, same as Nos. 36 and 38 in which the boring was discontinued	7	1	10
	103	0	0

This boring was commenced in the upper part of the Kimeridge Clay, a few feet below the base of the Spilsby Sandstone, and was probably still in the Kimeridge Clay when it was abandoned.

2. Section of Strata at same locality as No. 1, proved by diamond bore on the property of J. Stuart Bogg, Esq.

Bored by Mr. Andrew Kyle, and communicated by Mr. J. S. Bogg. 1904.

Strata.	Fms.	ft.	in.	Fms.	ft.	in.
Drift { Sandy soil	0	5	0	0	5	0
Drift { Flinty gravel	0	0	9	0	5	9
Sandy clay	0	2	9	1	1	9
Dark clay, stratified and fossiliferous	4	1	3	5	3	0
Lighter clay, stratified and fossiliferous	2	1	6	7	4	6
Darker clay, stratified and fossiliferous	0	1	6	8	0	0
Harder grey slate	0	1	2	8	1	2

Strata.	Fms.	ft.	in.	Fms.	ft.	in.
Lighter clay	1	1	0	9	2	2
Darker clay	3	4	0	13	0	2
Dark clay	1	2	0	14	2	2
Dark clay, thin shale ribs	0	5	7	15	1	9
Brownish shale	0	1	9	15	3	6
Dark clay	0	0	6	15	4	0
Shale with thin clay ribs	0	3	2	16	1	2
Bluish clay with fossils	0	4	1	16	5	3
Shale	0	0	9	17	0	0
Blue clay	0	2	6	17	2	6
Lighter clay	0	2	4	17	4	10
Inferior shale	0	0	3	17	5	1
Light clay with harder ribs	1	4	3	19	3	4
Light clay, harder	1	4	11	21	2	3
Light clay, softer with ribs	1	0	1	22	2	4
Light clay, hard	0	1	2	22	3	6
Light clay, softer	0	1	3	22	4	9
Brownish limey rib	0	0	4	22	5	1
Light clay	0	2	8	23	1	9
Darker clay	3	1	5	26	3	2
Inferior shale	0	1	2	26	4	4
Dark clay	1	0	3	27	4	7
Shale	0	0	8	27	5	3
Dark clay	0	0	6	27	5	9
Shale	0	0	8	28	0	5
Inferior shale	0	1	3	28	1	8
Shale	0	0	11	28	2	7
Inferior shale	0	0	10	28	3	5
Shale	0	0	8	28	4	1
Inferior shale	0	0	4	28	4	5
Hard lime rib	0	0	2	28	4	7
Dark clay	0	0	8	28	5	3
Shale	0	1	2	29	0	5
Dark clay	0	0	8	29	1	1
Shale	0	1	0	29	2	1
Dark clay	0	0	4	29	2	5
Shale	0	2	9	29	5	2
Inferior shale	0	0	7	29	5	9
Shale	0	0	6	30	0	3
Dark clay	0	0	11	30	1	2
Shale	0	1	2	30	2	4
Dark clay	0	0	6	30	2	10
Shale	0	4	7	31	1	5
Dark clay	0	1	1	31	2	6
Inferior shale	0	0	11	31	3	5
Shale	0	0	8	31	4	1
Inferior shale	0	0	9	31	4	10
Shale	0	1	0	31	5	10
Inferior shale	0	0	3	32	0	1
Shale	0	1	11	32	2	0
Dark clay	0	1	7	32	3	7
Shale	0	0	5	32	4	0
Dark clay	0	1	3	32	5	3
Shale	0	0	4	32	5	7

Strata.	Fms.	ft.	in.	Fms.	ft.	in.
Lighter clay	0	1	1	11	0	8
Shale	0	0	4	33	1	0
Dark clay	0	1	0	33	2	0
Dark clay	0	1	0	33	3	0
Shale	0	0	3	33	3	3
Dark clay	0	1	0	33	4	3
Shale	0	0	1	33	4	4
Hard pyritical rib (iron)	0	0	2	33	4	6
Shale	0	0	3	33	4	9
Lighter clay	0	0	6	33	5	3
Dark clay	0	5	9	34	5	0
Inferior shale	0	0	4	34	5	4
Dark clay	0	5	0	35	4	4
Dark clay, with shaly ribs	0	4	2	36	2	6
Ironstone rib	0	0	1	36	2	7
Bluish clay, shaly next bottom	0	0	11	36	3	6
Dark clay	0	3	4	37	0	10
Inferior shale	0	1	8	37	2	6
Dark clay	0	0	8	37	3	2
Shale	0	0	2	37	3	4
Dark clay	0	0	2	37	3	6
Shale	0	0	2	37	3	8
Dark clay	0	1	6	37	5	2
Shale	0	0	7	37	5	9
Inferior shale	0	0	7	38	0	4
Shale	0	0	8	38	1	0
Dark clay	0	0	10	38	1	10
Inferior shale	0	0	9	38	2	7
Shale	0	0	5	38	3	0
Inferior shale	0	0	10	38	3	10
Shale	0	0	5	38	4	3
Dark clay	0	0	10	38	5	1
Shale	0	0	1	38	5	2
Dark clay	0	0	5	38	5	7
Shale	0	0	2	38	5	9
Dark clay	0	0	10	39	0	7
Shale	0	0	3	39	0	10
Dark clay	0	1	6	39	2	4
Shale	0	0	6	39	2	10
Dark clay	0	1	1	39	3	11
Shale	0	0	5	39	4	4
Dark clay	0	0	6	39	4	10
Shale	0	0	5	40	0	0
Dark clay	0	0	9	40	0	9
Shale	0	0	6	40	1	3
Gritty limestone	0	0	1	40	1	4
Dark clay	0	0	6	40	1	10
Shale	0	0	4	40	2	2
Ironstone	0	0	3	40	2	5
Shale	0	1	6	40	3	11
Dark clay	0	2	2	41	0	1
Shale	0	0	7	41	0	8
Dark clay	0	1	6	41	2	2

Strata.	Fms.	ft.	in.	Fms.	ft.	in.
Inferior shale	0	0	5	41	2	7
Shale	0	0	10	41	3	5
Blue clay	0	1	6	41	4	11
Brownish shale	0	2	2	42	1	1
Dark clay	0	1	6	42	2	7
Shale	0	4	4	43	0	11
Hard gritty rib	0	0	1	43	1	0
Dark clay	0	1	6	43	2	6
Brownish shale	0	0	5	43	2	11
Dark clay	0	1	6	43	4	5
Brown shale	0	0	2	43	4	7
Inferior shale	0	1	8	44	0	3
Shale	0	0	3	44	0	6
Dark clay	0	1	6	44	2	0
Shale	0	0	5	44	2	5
Dark clay	0	2	10	44	5	3
Shale	0	0	4	44	5	7
Dark clay	0	0	7	45	0	2
Inferior shale	0	3	5	45	3	7
Shale	0	0	6	45	4	1
Dark clay	0	4	2	46	2	3
Blue clay, harder. *Ammonites longispinus*, Sow	0	2	11	46	5	2
Inferior shale. *Am.* near to *Eumelus*, d'Orb	0	0	6	46	5	8
Light clay	0	1	4	47	1	0
Shale	0	0	2	47	1	2
Light clay	0	1	0	47	2	2
Darker clay	0	2	7	47	4	9
Inferior shale. *Exogyra virgula*, Defr.	0	0	6	47	5	3
Dark clay	0	0	9	48	0	0
Inferior shale	0	0	6	48	0	6
Shale	0	1	2	48	1	8
Dark clay	0	0	11	48	2	7
Shale	0	0	10	48	3	5
Dark clay. *Astarte?*	0	1	4	48	4	9
Shale. *Ammonites*	0	0	7	48	5	4
Dark clay	0	1	2	49	0	6
Shale	0	0	4	49	0	10
Inferior shale. *Am. alternans*, von Buch.	0	0	7	49	1	5
Shale. *Ammonites*, Fish-bone	0	1	4	49	2	9
Inferior shale	0	0	10	49	3	7
Dark clay	0	1	2	49	4	9
Inferior shale	0	0	6	49	5	3
Shale. *Astarte hartwellensis*, Sow	0	0	9	50	0	0
Dark clay	0	1	6	50	1	6
Shale. *Am.* near to *Eumelus*, d'Orb	0	0	6	50	2	0
Dark clay. *Lingula ovalis*, Sow	0	1	1	50	3	1
Shale	0	0	5	50	3	6
Dark clay, shale ribs next top	0	1	4	50	4	10
Shale	0	1	1	50	5	11
Dark clay. *Am. pallasianus*, d'Orb	0	1	9	51	1	8
Dark clay	0	0	4	51	2	0
Shale	0	0	6	51	2	6

Strata.	Fms.	ft.	in.	Fms.	ft.	in.
Dark clay	0	0	3	51	2	9
Shale	0	1	0	51	3	9
Dark clay	0	1	0	51	4	9
Shale. *Ammonites*	0	0	7	51	5	4
Dark clay. *Am. mutabilis?* Sow	2	3	2	54	2	6

Total depth 326 feet 6 inches.

The entire series below the Drift belongs to the Kimeridge Clay. The Clays were nearly all dark coloured and highly fossiliferous. The fossils have been identified by Mr. E. T. Newton.

We have given all the material that was inflammable the name of Shale. (See Analyses p. 217.)

Our term "Inferior Shale" is when the material had as much bituminous matter as to burn with a flame, and "Shale" when it was more inflammable, and burned brightly and easily.

3. About 300 yards west of the church.

Communicated by Mr. James Freeborough, well-sinker.

		Ft.
Boulder Clay.	White marl	30
	Blue and white clay mixed	12
To Kimeridge Clay.	Black shale with dice (water rose quickly).	—
		42

Billingborough.

(1 in. Map 70, N.S. 143 ; 6 in. Map 124 N.E.)

J. Addy, *Proc. Inst. Civ. Eng.*, vol. lxxiv., p. 161.

1. Boring.

Water rose about 20 feet above surface.

		Ft.
Old Well		10
Quicksand		23
[Great Oolite Clay]	Blue clay	14
[Great Oolite Limestone]	Blue rock	14
[Upper Estuarine Series]	Blue, green, and black clay	26
		—
Lincolnshire Limestone]	Rock at	87

2. Boring.

Water rose 2 to 3 feet above surface.

		Feet.
	Mixed clay	37
	Blue rock	14
	Blue clay	4
[Great Oolite Limestone]	Rock and kale (with plentiful supply)	4
[Upper Estuarine Series]	Blue, green and black clay	28
		—
		87

3. Boring.

		Ft.
Old Well		10
[Great Oolite Clay]	Blue clay	4
	Rock	4
	Blue clay	19
[Great Oolite]	Blue rock	14
	Clay	4
	Rock and kale (yielding good supply above surface)	4
[Upper Estuarine Series]	Blue, green, and black peaty clay and kale	28
[Lincolnshire Limestone]	Kale	8
		95

4. Crownlands, Beacon Hill,
Billingborough Fen (6 in. Map 125 N.W.).
Communicated by Messrs. Barnes and Sharpe, Sleaford.

		Ft.
Fen Deposits	Yellow clay	8
	Blue sand	20
Cornbrash	Rock	8
Great Oolite Clay	Clay	21
Great Oolite Limestone	Rock	11
Upper Estuarine Series	Green clay	10
	Rock	6
	Clay	23
Lincolnshire Limestone	Rock (water)	88
		195

See also Analyses, p. 200.

Billinghay.

(1 in. Map 83, N.S. 115; 6 in. Map 88 S.W.)
Boring made by Messrs. Barnes and Sharpe, Sleaford. 1902.
Communicated by Mr. Jesse Clare to Mr. H. Preston.
Height above O.D., 9 ft. No water.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil		3	0	3	0
Boulder clay 60 ft.	Blue clay with chalk stones	30	0	33	0
	Red clay	30	0	63	0
Oxford clay and Kellaways Beds	Clay	165	0	228	0
	Rock	10	0	238	0
	Dark blue clay	11	0	249	0
Cornbrash	Rock	8	0	257	0
Great Oolite Clay	Clay	21	6	278	6
Great Oolite Limestone 26 feet	Rock	16	0	294	6
	Clay	4	0	298	6
	Rock	6	0	304	6
Upper Estuarine Series	Clay	15	0	319	6
Lincolnshire Limestone 98 feet	Rock	50	0	369	6
	Clay	2	0	371	6
	Rock	46	0	417	6
Upper Lias	Clay to	2	0	419	6

Bilsby.

(1 in. Map 84, N.S. 104 ; 6 in. Map 66 S.E.)

1. Mrs. Kemp's house, two furlongs S.E. of the Church.
Communicated by Mr. J. Bingley, of Aby (well-sinker).

	Ft.
Clay, with whites	73
Sand	3
Rock [Chalk]	12
	88

2. Another well at Bilsby was bored through 60 feet of clay, finding water in the sand below.

3. At the Hall near the Church.
Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker).

		Ft.
[Glacial Drift]	Clay, mixed with sand (Hessle Clay)	15
	Clay, with stones (Purple Clay)	40
	Sand	15
Chalk		1
		71

4. Well at Mrs. Kemp's, Thurlby.
Communicated by Mr. J. Bingley, of Aby (well-sinker).
Dug 11 feet, the rest bored.

		Ft.
[Glacial Drift]	Clay (Boulder Clay)	59
	Sand	3
[Chalk]	Rock	15
		77

Birthorpe.

(1 in. Map 70, N.S. 143 ; 6 in. Map 124 N.E.)

1. Crown Lands, Birthorpe.
Communicated by Messrs. Barnes & Sharpe, Sleaford.

Water level fluctuating from 15 to 40 feet from surface. Supply abundant, and quality very good.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Drift and Kellaways Beds	Clay	9 0	9 0
	Sandstone	19 6	28 6
	Clay	4 0	32 6
Cornbrash	Rock	7 6	40 0
Great Oolite Clay	Clay	21 6	61 6
Great Oolite Limestone	Rock	11 0	72 6
Upper Estuarine Series	Clay	9 0	81 6
	Rock	2 0	83 6
	Clay	19 6	103 0
Lincolnshire Limestone	Oolite	97 0	200 0

2. Sempringham Fen. (6 in, Map, 125 N.W.)

Communicated by Messrs. Barnes & Sharpe, Sleaford.

Large supply of water, which rose above surface.

		Thickness.	Depth.
		Ft. in.	Ft.
	Soil	1 0	1
Fen Deposits	Clay	6 0	7
	Gravel	2 0	9
Oxford Clay and Kellaways Beds	Clay	16 0	25
	Rock	10 0	35
	Clay	13 0	48
Cornbrash	Rock	5 0	53
Great Oolite Clay	Clay	24 0	77
Great Oolite Limestone	Rock	7 0	84
Upper Estuarine Series	Clay	41 0	125
Lincolnshire Limestone	Oolite	7 0	132

Boothby Pagnall.

(1 in. Map 70, N.S. 143 ; 6 in. Map 123 S.W.)

Well nearly opposite church, for supply of village and Boothby Hall.

Date 1899. Sunk 132 feet ; bored 49 feet.

Communicated by the Hon. Maurice R. Gifford to Mr. Henry Preston.

Height above O.D., 291 feet. Water level, 116 feet from surface.

		Thickness.	Depth
		Ft. in.	Ft. in.
Surface deposits 6 ft.	Soil	4 0	4 0
	Sand	2 0	6 0
Great Oolite Clay	Kale	10 0	16 0
Great Oolite Limestone	Hard rock	2 6	18 6
Upper Estuarine Series	Coloured clay	19 6	38 0
	Ironstone	1 0	39 0
Lincolnshire Limestone	White and blue rock	132 0	171 0
Northampton Beds	Hard blue sandy limestone. Seam of clay about 2 inches thick at 172 feet	9 0	180 0
Upper Lias	Blue clay	1 0	181 0

In this well a strong air-blast was found coming from a fissure in the Limestone at a depth of 106 feet from surface (see *Naturalist*, Oct. 1899).

2. Well, ½ mile west of church, made by Mr. F. Hobson, (well sinker.) Communicated by Mr. Henry Preston.

Height above O.D., 373 feet. Water 2 feet deep in well. Yield, small supply.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil		1 0	
Boulder Clay	Clay with stones	37 0	38 0
Great Oolite Limestone	Hard rock	2 9	40 9
Upper Estuarine Series	Blue clay	4 3	45 0

Boston.

(1 in. Map 69, N.S. 128 ; 6 in. Map 109 S.W.)

The town was supplied in 1849 with water from a reservoir constructed by Thomas Hawksley to the south-west of Miningsby, about 120 feet above the level of Boston and twelve miles distant. "The reservoir, which covers an area of 34 acres, and contains when full about 75,500,000 gallons, was formed by damming back the water of a small brook. The gathering ground, which lies between the villages of Miningsby and Asgarby, covers an area of about three square miles, and consists mainly of agricultural land. The source of the brook by which the reservoir is fed is a spring near the village of Asgarby, which crops out at the junction of the green-sand (Spilsby Sandstone), and Kimmeridge clay. From this spring, however, there is not much flow except in the months of January and February. For the most part it is surface water alone that finds its way to the reservoir." * The reservoir and the greater part of the gathering ground are on Boulder-clay.

Thompson records that as early as 1568 attention was given to the subject of procuring water from a distance for the use of the inhabitants of Boston. In that year, according to the Corporation Records, "four aldermen and four common councillors were appointed to consider by what manner water might be brought from Kele Hill," while "The Mayor and William Derby were appointed at a subsequent meeting to travel with the Commissioners of Sewers, to see whether fresh water may be conveyed out of Hilldyke to the borough of Boston." Thompson adds that "There is not any later notice of either of these projects. How the town was supplied with water at this time is not known."

In 1705 reference is made to a cistern in the market-place "for the holding of fresh water for the furnishing of this borough."

"In 1747, Thomas Partridge was employed to bore for water in the market-place. The attempt was relinquished after penetrating to the depth of 186 feet." (See p. 57.) "In 1783, and the two succeeding years, the Corporation spent £440 in another attempt to procure water for the town ; the depth then reached was 478 feet, when, there being no prospect of success, the design was abandoned."†

* Dr. S. M. Copeman, Report to Local Government Board, 1901 ; *see also* Pishey Thompson, The History and Antiquities of Boston, 1856, p. 102.

† The History and Antiquities of Boston, 1856, pp. 67, and 96–98.

Later and unsuccessful attempts to obtain water by boring were made in 1826–28. Particulars of some of these are herewith given.

1. Market Place, 1747 and 1783.

Communicated by James Limbird, Surveyor to the Corporation, *Phil. Trans.* lxxvii., 1787, p. 50.

Sunk and bored to depth of 186 feet from surface by Thomas Partridge, in 1747; and continued by George Naylor, well-borer, of Louth, 7 May to Nov. 1783. Well 6 ft. diam. at surface, 5 ft. at bottom, and 27 ft. deep.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
[Fen Deposits]	Earth	21	6	21	6
	Blue clay	14	6	36	0
	Sand and gravel	1	6	37	6
	Blue clay	10	6	48	0
	Dark coloured stone like ragstone (salt water)	—	6	—	6
	Dark blue clay	26	6	75	0
	Stone	—	6	75	6
	Dark blue clay	38	6	114	0
	Stone	—	8	114	8
	Gravel (salt water)	—	6	115	2
	Dark coloured clay	58	10	174	0
	Chalky clay with small pebbles and flints	—	3	174	3
	Dark coloured clay	11	9	186	0
	Dark coloured clay	24	0	210	0
	Lighter coloured clay	—	6	210	6
	Dark coloured clay	131	6	342	0
	White earth and shells (½ inch) Lighter coloured clay [seam as above] } about	—	6	342	6
	Dark coloured clay	104	6	447	0
	Dark coloured earth mixed with chalk and gravel	2	10	449	10
	Dark coloured earth with very little gravel	4	9	454	7
	Dark coloured earth mixed with chalk and gravel	2	1	456	8
	Dark coloured earth with very little gravel	—	4	457	0
	Do., lighter	5	4	462	4
	Do., dark as before	7	11	470	3
	Dark coloured earth mixed with chalk and gravel	—	4	470	7
	Stone like ragstone	1	1	471	8
	Dark coloured earth with little gravel	—	4	472	0
	Lighter earth—appears to be mixed with chalk and gravel	—	3	472	3
	Dark coloured silt with chalk and gravel	3	2	475	5
	Dark coloured wet silt	3	3½	478	8½

Saline water of small amount rose to within 255 feet of the surface, and was attributed to soakage from above. This was the opinion of John Farey as given in a letter to Sir Joseph Banks dated 1808.* Farey also remarks: "There is a material distinction to be observed with regard to the term gravel, which has hitherto been overlooked by most practical well-diggers and borers, for they call the rubble of any loose rock or small pieces of stony substance, which their augers or buckets bring up out of the earth, by the name of gravel . . . . The ragstone mentioned at 48½ feet, and the gravel at 115 feet 2 inches of depths, were, as I conceive, only layers of the extraneous fossils or stony nodules called ludus helmontii, with which this clay abounds, and possibly these may, in this case, form such a continuous bed as to communicate with the sea, and produce salt-springs, because the layers of such nodules or clay balls, in the London clay strata, are known to produce small springs in several places in the wells of Middlesex and Surrey . . . . The chalk, small pebbles, and flints, if any such were really brought up from the depth of 174½ feet, could, as I conceive, have come there only by falling down the hole from the alluvial gravel first mentioned, after being detached by the friction and swagging of the rods, or by the nose of the auger in returning it into the hole; . . . . I see no evidence to contradict a supposition that many of these, denominated gravel and chalk, were in reality fragments and chippings of ludus helmontii [septaria], or of clunch. . . . .

Farey gave good reasons for believing that the Bedford (Sleaford) Limestone [=Great Oolite] might be met with at a depth of 500 or 600 feet below Boston, and that at a lower level, the Barnack ragstone (of the Ancaster hills) [=Lincolnshire Limestone] "will doubtless furnish a powerful spring of water that under proper management in pipes, would rise, and supply every street and building in the town of Boston with water." He concluded that the strata passed through in the boring were:—

	Ft.
Alluvial silt, clay, sand, and gravel	37½
Clunch-clay strata	441

Thompson quotes the following record of a boring stated (in the MS. Minutes of the Spalding Gentleman's Society), to have been made by Thomas Partridge in "1746," near the old leaden Corn Market Cross.†

———	Thickness.		Depth.	
	Ft.	in.	Ft.	in.
Sand	3	0	3	0
Made earth (old surface)	5	0	8	0
Stones and gravel	3	0	11	0
Clay	5	0	16	0
Stones, rubble, and a sort of chalk	3	0	19	0
Clay with many small hardstones not pierced	173	0	192	0

The date of the above should no doubt be 1747 as given by James Limbird (*ante*, p. 57.)

2.—Market Place, 1826.

Trial borings made at expense of John Wilks, M.P. "His first operations were made very near the place where Naylor had unsuccessfully bored for water to the depth of 478 feet in 1785. After boring 560 feet, the attempt failed, through the breaking of part of the apparatus.

* Thompson's Hist. and Antiq., Boston, pp. 668–671.

† *Op. cit.*, p. 666.

"The second trial was made near the churchyard, under the direction of Messrs. William Wedd Tuxford and Peter Tuxford, of Boston. This perforation was made to the depth of 565 feet; when, owing to some defect in the piping, which severed at the depth of 40 feet from the surface, a quantity of loose sand fell into the vacant space, choked up all below, and rendered further attempts, either to continue the project on that spot, or to recover the piping, entirely unavailing. Messrs. Tuxford commenced a third attempt within twenty-four hours of the failure of this second one. This was made on the western side of the Market Place . . . . but the great desideratum of a supply of water was not obtained."*

3. Western side of Market Place, 1828 (May 3rd to August 3rd). Bored by Messrs. W. W. and P. Tuxford. From Thompson's History of Boston, p. 673.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Fen Beds.	Loose earth	12	0	12	0
	Loose earth, mixed with silt	12	0	24	0
	Very hard earth, mixed with stone	12	0	36	0
	Very stony, mixed with clay	14	0	50	0
	Clay and shells	45	0	95	0
	Dark clay and large flints	35	0	130	0
	Clay stones, and shells	20	0	150	0
	Clay and large stones	16	0	166	0
	Very dark clay and stones	13	0	179	0
	Clay and stones	11	0	190	0
	Very dark clay and shells	110	0	300	0
	Dark clay	28	0	328	0
	Light slate-coloured clay, with large shells	22	0	350	0
	Dark clay and shells	22	0	372	0
	Dark clay and large shells	43	0	415	0
	Dark clay	38	0	453	0
	Clay, with great quantity of shells	31	0	484	0
	Shells, shingle, dark clay, and sharp sand	2	0	486	0
	Remarkably fine sharp sand	3	0	489	0
	Ditto and dark clay	9	0	498	0
	Clay and very large shells	7	0	505	0
	Shingle flints and shells	3	5	508	5
	Rock. Messrs. Tuxford, who sank the well, say:—"It is supposed possible that some hard substance may have fallen in, causing the appearance of 'rock' at these depths"	2	1	510	6
	Stones mixed with clay	12	4	522	10
	Clay, shells, and flint	7	0	529	10
	Stone, shells, and rock	18	2	548	0
	Very dark clay	7	0	555	0
	Very fine white sand	11	0	566	0
	A dark umber like earth, soft and hard by turns	6	0	572	0

* Thompson's Hist. and Antiq., Boston, p. 672.

In the Memoir on the Geology of the Fenland (pp. 211, 279) Mr. Skertchly regarded the whole of the section of 572 feet to be in Fen Beds and Drift. The evidence was subsequently discussed by Mr. Jukes-Browne,* from whose remarks the following are quoted :—

"Depending on this record and mainly on the fact that between the depths of 523 and 530 feet 'clay shells and flints' are said to have occurred, Mr. Skertchly regards the section as giving evidence of the extension of the Glacial series to the enormous depth of nearly 600 feet below Boston.

"I cannot but think, however, that the evidence on which this supposition rests is too weak and uncertain to support so startling a conclusion. . . .

"In Cambridgeshire, however, the term 'flint' is said to be sometimes applied to hard beds and concretions in the Jurassic clays. . . .

"It is quite possible, not to say probable, that the greater part of this boring lies in the Kimeridge and Oxford clays. . . . Beds of rock and sandstone are known to occur in and between these clays not far to the southward. . . .

"Now assuming that the lower part of the boring is in the Oolitic Series, it becomes important to determine, if possible, the base of the boulder clay; and in the first place it may be noted that the boring at Fossdyke (only 7 miles south of Boston) reached the bottom of this clay at a depth of 166½ feet, passing immediately into Kimeridge Clay with septarian bands which was bored to a further depth of 159½ feet. If we examine the account of the Boston well we find that stones are repeatedly mentioned as occurring in the clay down to a depth of 190 feet, but that below this [level] there is no recorded occurrence of stones throughout a thickness of 294 feet. All this portion of the section is described as 'dark clay with shells,' except a band in the middle, 22 feet thick, of 'light slate-coloured clay with large shells.' Such a description applies far better to the Kimeridge or Oxford Clay than to Boulder Clay, for it would be surprising that no stones should have been met with in boring through a thickness of nearly 300 feet of Boulder Clay. Moreover, if we place the base of the Boulder Clay at 190 feet the section then agrees very fairly with the more recent and more accurately described boring at Fossdyke." [Fosdyke, see p. 97.]

"It was then pointed out that the real difficulty lay in the interpretation of the lower 88 feet of the boring, which is stated to have passed through a varied series of sands, clays, and rock-beds; and I suggested that these might be a local development of Corallian Beds between the Oxford and Kimeridge Clays. A reconsideration of the matter has, however, induced me to alter my opinion. The thickness of Oxford Clay which comes in beyond the western border of the Fenland in Sheet 70 [old series] is very small; its easterly dip is also so small as to be inappreciable in the brickyard exposures, and in all probability it becomes really *nil* under the central part of the Fenland. Now Boston is only about fifteen miles from the outcrop of the Kellaways Beds near Sleaford, and if we allowed a dip of half a degree throughout the whole distance (which is probably an excessive estimate) the thickness of beds brought in below Boston will be only 630 feet, which is only 58 feet more than the 572 feet proved. Moreover, the Kellaways Beds do consist of alternations of white sand, clay, and sandy rock, with fossils."

"Consequently I am now inclined to believe that this boring traversed the whole of the Oxford Clay and the Kellaways Beds, and may possibly

* *Quart. Journ. Geol. Soc.*, vol. xxxv., p. 418 (1879).

even have entered the Great Oolite Clay. The succession of formations pierced by this boring may therefore be summarised as follows" :—

		Ft.
Fen Beds	Loose earth and Silt	24
Boulder Clay 166 feet.	Hard earth with stones	26
	Clay with stones, flints, and shells	140
Kimeridge and Oxford Clays 294 feet.	Dark clay with shells	138
	Light-coloured clay with shells	22
	Dark clays with shells	134
Beds at and below base of Oxford Clay, 88 feet. [Kellaways Beds and Great Oolite Series.]	Fine sand and clay	21
	Stones and rock	5½
	Clay with stones and shells	19½
	Stone, shells, and rock	18
	Dark clay	7
	White sand	11
	Brown earth	6
		572

The above remarks by Mr. Jukes-Browne may be compared with those made by Farey (p. 58).

4. Skirbeck Quarter, Boston,
21·9 feet above low-water in Boston Deeps.
From Mr. W. H. Wheeler.

			Thickness.		Depth.	
			Ft.	in.	Ft.	in.
Alluvium	Clay and Silt	Silty clay	5	6	5	6
		Blue clay	3	6	9	0
		Silty clay	6	0	15	0
		Soft buttery clay, more moist	2	10	17	10
		Silty clay	0	5	18	3
	Peat, sandy at bottom		1	4	19	7
	Sand	Sharp sand, especially last 4 ins.	0	9	20	4
		Sharp sand, greyish yellow; water rose	0	11	21	3
		Sharp sand	0	11	22	2
		Sand, clay, and small stones	0	6	22	8
		Sharp sand	2	10	25	6
Boulder Clay—Clay with chalk-stones			0	4	25	10

5. Nearer the road than the above.
Communicated by Mr. W. H. Wheeler.

		Thickness.		Depth.	
		Ft.	in.	ft.	in.
Fen Beds.	Clay and silt	17	9	17	9
	Peat	1	6	19	3
	Sand	4	9	24	0
Boulder clay		0	6	24	6

6. Boring at the Grand Sluice on the River Witham, 1½ miles above the Docks.

Communicated by Mr. W. H. Wheeler.

		Thickness.	Depth.
		Ft.	Ft.
Fen Beds.	Alluvial Soil	10	10
	Clay	2	12
	Soft clay	1	13
	Soft black clay, with cockle shells	4	17
	Very soft clay	5	22
	Peat	1	23
	Sand	5	28
Glacial Beds.	Hard clay	1	29
	Sand	1	30
	Boulder Clay of a black colour, with small chalk-stones, bored for	9	39

N.B.—The Boulder Clay here is much blacker in colour than at the Docks and has less chalk in it.

7. Borings made to test the ground before the construction of Boston Docks.

Communicated by Mr. W. H. Wheeler.

		Thickness.	Depth.
		Ft.	Ft.
	No. 1.		
Fen Beds.	Soil and rubbish	4	4
	Loamy clay	1	5
	Brown clay (a good brick clay)	4	9
	Loam and silt	1	10
	Brown clay	2	12
	Clay with specks of peat	2	14
	Clay and peat	1	15
	Peat and sand	3	18
	Sand and yellow clay	1	19
Boulder Clay		4	23
	No. 2.		
Fen Beds.	Blue clay	4	4
	Brown clay	2	6
	Blue clay	5	11
	Clay with specks of peat	4	15
	Clay and shells	3	18
	Sand and peat	1	19
Boulder Clay		4	23

8. Borings at the Witham Outfall Works near Clayhole.

Communicated by Mr. W. H. Wheeler.

	No. 1 on the Enclosed Land.	Ft.	No. 2 on the Foreshore.	Ft.	No. 3 at Low Water-Mark.	Ft.
Fen Beds.	Alluvial soil	5¾	Sand and silt	3	—	
	Brown clay	3	Brown clay	3	—	
	Blue clay	1	Blue clay	3	Blue clay	6
	Peat	0½	Peat	1	Peat	1
	Sand	0½	Sand	0½	Sand	1
Boulder Clay		—	Boulder Clay	—	Boulder Clay	—

See also Analyses, p. 197.

Boultham.

(1 in. Map 83, N.S., 114; 6 in. Map 70 S.W.).

1. Trial-boring for water on the site of the filter-beds of the Lincoln Waterworks.

Communicated by Mr. J. H. Teague to Mr. Cameron.

	Ft.
Soft mud	6
Harder sand and clay with some water	6
Very hard coarse sand	8
Clay becoming very hard below	17
	37

2. A boring for the supply of Lincoln has been commenced at Boultham. If successful it will be the deepest boring for water in England. See P. Griffith (*Water*, ii. (1900), 60, 396); also *Water*, iv. (1902), 290.

Height above O.D., 20 ft.

The following details (1903–4) have been communicated by Mr. J. H. Teague to Mr. Henry Preston:—

	———	Thickness.	Depth.
		Ft. in.	Ft. in.
Drift	Soil and peat	6 0	6 0
	Sand and gravel	16 0	22 0

2. Boring for the supply of Lincoln—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Lower Lias	Blue shale (with *Ammonites* at 36 ft.)	84 3	106 3
	Thin ironstone-band	0 6	106 9
	Blue shale full of *Gryphœa*	4 9	111 6
	Band of concretions	0 4	111 10
	Blue shale with *Gryphœa* and *Ammonites*	38 9	150 7
	Blue shale	15 6	166 1
	Very hard bed of *Gryphœa*	0 8	166 9
	Blue shale with occasional concretions and iron-pyrites: *Gryphœa*	164 1	330 10
	Blue shale with *Ammonites*	20 0	350 10
	Blue shale	12 10	363 8
	Hard band of *Gryphœa*	0 6	364 2
	Blue shale with *Gryphœa*	34 3	398 5
	Hard *Gryphœa* bed	1 6	399 11
	Blue shale with occasional concretions and *Gryphœa*	140 1	540 0
	Hard blue and grey shale and rock	80 0	620 0
	Blue shale with *Ammonites planorbis*	20 0	640 0
Rhætic Beds	Dark liver-coloured marl	14 0	654 0
	Black shales	23 0	677 0
	Grey earthy limestones	22 0	699 0
Keuper Marls	Bed of gypsum	2 6	701 6
	Red marl	4 6	706 0
	Bed of gypsum	3 0	709 0
	Red marl with thin bands of gypsum	11 0	720 0
	Hard grey rock with gypsum	10 0	730 0
	Red marl	10 0	740 0
	Grey rock with gypsum	7 0	747 0
	Red marl and gypsum	3 0	750 0
	Hard blue-grey rock	16 0	766 0
	Red marl and bands of hard grey rock	64 0	830 0
	Very fine clear gypsum	6 0	836 0
	Red marl and bands of hard blue and grey rock	48 0	884 0

(*Boring in progress.*)

Bourn.

(1 in. Map 64, 70, N.S. 143; 6 in. Map 140 N.E.)

1. Prior to the year 1856 Bourn was supplied with water partly from shallow wells, "but many of the houses were wholly dependent upon carts, which fetched water from a considerable distance. In that year a four-inch boring was made to a depth of 92 feet through alluvial soil, gravel and Oolitic strata, till it reached a stratum, 6 feet thick, of compact and hard rock, in passing through which, at 92 feet below the surface, the tool fell suddenly about 2 feet evidently into a chasm or hollow, striking upon the hard surface of the underlying rock. The water immediately rushed up with great force. . . . The water rose at the Town Hall exactly 39 feet 9 inches above the ground." The yield was about 570,000 gallons a day.*

* J. Pilbrow, *Proc. Inst. C.E.*, lxxv. (1884), 245. J. Addy, *ibid.*, lxxiv. (1883), 160.

2. Star Lane.

For the Waterworks. Boring 5½ and 3 in. Water rose to 41 ft. above surface, 1880.

J. Addy, *Proc. Inst. C.E.*, lxxiv. (1883), 161.

		Thickness		Depth.	
		Ft.	in.	Ft.	in.
Soil and Oxford Clay.	Shaft	–	–	4	6
	Clay	11	0	15	6
Cornbrash.	Blue rock	6	0	21	6
Great Oolite Clay.	Black clay	4	0	25	6
	Yellow clay	3	0	28	6
	Rock	0	4	28	10
	Dark clay	8	8	37	6
Great Oolite Limestone.	Rock	11	0	48	6
	Chalky clay	9	0	57	6
	Hard rock	9	0	66	6
Upper Estuarine Series.	Clay	4	0	70	6
	Soft rock	3	0	73	6
	Hard, close, tough, dark clay	13	0	86	6
Lincolnshire Limestone.	Water rock	3	0	89	6

3. Top of West Street.

For the Waterworks, 1888. Made by Messrs. C. Isler & Co.
Communicated by Messrs. Easton & Anderson.

Bored throughout, and tubed to the depth of 89½ feet. Water flowed 4 feet above the surface. Yield at a depth of 99 feet about 300,000 gallons in twenty-four hours. Subsequently deepened to 120 feet, and gave 864,000 gallons a day.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil		4	0	4	0
Drift	Silty sand	2	0	6	0
Oxford Clay.	Dicey clay	8	0	14	0
	Blue sandstone	1	0	15	0
Cornbrash	Limestone rock	8	0	23	0
Great Oolite clay, 19 ft. 7 in.	Blue clay	2	7	25	7
	Dark clay	1	5	27	0
	Green marlstone	1	0	28	0
	Green marl	4	0	32	0
	Dicey clay	2	0	34	0
	Clay and shells	1	0	35	0
	Clay and silty sand	1	7	36	7
	Dicey clay	6	0	42	7
Great Oolite Limestone, 14 ft. 5 in.	Rock and shells, very hard	9	0	51	7
	Light blue clay	1	5	53	0
	Green clay	3	0	56	0
	Green marlstone, with water	1	0	57	0

3. Top of West Street—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Upper Estuarine Series, 29ft.	Dark blue clay	1 0	58 0
	Dark brown clay	1 0	59 0
	Dark blue clay and shells	1 0	60 0
	Blue soft rock. Water (rose 54 ft.)	4 0	64 0
	Light-coloured clay and shells	1 4	65 4
	Brown clay	1 0	66 4
	Dark brown clay	3 8	70 0
	Brown clay	1 0	71 0
	Dark green clay and silty sand	2 0	73 0
	Dark brown clay	1 0	74 0
	Grey clay or pipeclay	12 0	86 0
Lincolnshire Limestone.	Sandstone [limestone] with water	1 0	87 0
	Blue clay and chalk [calcareous matter	1 0	88 0
	Sandstone [limestone] rock, with water	32 0	120 0

Mr. F. S. Courtney (of Messrs. Easton and Anderson's) writes as follows:—"The water tapped in this district, at a depth of about 98 feet, is very plentiful and the standing level is in many cases as much as 20 feet above the surface. There are several borings in the neighbourhood, but I do not know of any of the former ones which were tight: in every boring I have examined, a large proportion of the supply finds its way up the outside of the bore-pipe, and, meeting with some of the more friable strata at a higher level escapes. In this boring a double lining has been provided (10 inches in diameter to a depth of 44½ feet, the rest 5 inches in diameter and reaching nearly to the surface), a sound joint having been made between the two. The boring is, I believe, quite tight. Two borings, made in recent years, within a mile of this boring, for the Spalding Water Company, in which no special care was taken, are unsatisfactory."

According to *The Engineer*, vol. lxv., p, 181 (1888), "this town is the only one in the United Kingdom which gets its supply direct from the source without pumping," referring, of course, to well-supplies only.

4. Great Northern Railway Station.

Made and communicated by Messrs. C. Isler & Co. to Mr. Whitaker, 1895

Good supply of water, rising 19 feet above the surface.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Dry well (the rest bored)		– –	6 0
Kellaways Beds.	Hard sandy clay	4 0	10 0
	Sandstone	6 0	16 0
	Hard black sandy clay	7 6	23 6
Cornbrash.	Hard blue limestone	8 6	32 0
Great Oolite Clay.	Hard mottled clay	8 0	40 0
	Hard clay	8 0	48 0
Great Oolite Limestone.	Rock and shell	4 0	52 0
	Hard rock	3 0	55 0
	Very hard limestone	2 6	57 6

4. Great Northern Railway Station—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Upper Estuarine Series.	Hard green sandy clay - -	8 6	66 0
	Hard marly clay - - -	9 0	75 0
	Hard chocolate [coloured] clay -	21 0	96 0
Lincolnshire Limestone.	Oolite limestone - - -	38 0	134 0
	Hard rock - - - -	16 0	150 0

Mr. J. Addy mentions a 4-in. bore at the Great Northern Railway station, carried to depth of 90 feet, when water rose nearly 50 ft. above surface. *Proc. Inst. C.E.*, lxxiv. (1883), 160.

5. Spretchley's Brewery for the Spalding Waterworks. Old Well. Information from Mr. E. Easton.

		Ft.
[Fen Beds and Drift.]	Hard deposits, silt, clay, and chalk - - -	20
[Cornbrash.]	Limestone rock - - - - - -	8
[Great Oolite Clay.]	Hard dark clay - - - - - -	5
	Green clay - - - - - - -	3
	Rock - - - - - - - -	2
	Dark heavy clay - - - - - -	8
	Light coloured clay with powdered chalk [? "race"]	17
[Great Oolite Limestone.]	Rock - - - - - - - -	4
	Clay and powdered chalk - - - -	6
	Hard rock - - - - - - -	2
[Upper Estuarine Series.]	Green and yellow sand - - - - -	15
		90

6. Spalding Waterworks.*

Made and communicated by Messrs. C. Isler & Co., 1893–94.
? 78 feet above Ordnance Datum.
Shaft 6 feet, the rest a boring of 13 inches diameter.
Water rises 34 feet above the ground.

Chalybeate water was found at a depth of 65½ feet and was shut out. The main springs were tapped at 78½ feet, the water then rising very slowly and taking twenty-four hours to overflow. Deeper, the volume increased rapidly and the overflow was 1,872,000 gallons a day at the depth of 100 feet, 2,592,000 at 120, and over 5,000,000 at 134.

		Thickness	Depth.
		Ft. in.	Ft. in.
Made ground	- - - - - -	2 0	2 0
Drift.	Clay - - - - -	1 6	3 6
	Gravel - - - -	1 0	4 6
Kellaways Beds	Clay - - - - -	2 0	6 6
	Loamy clay - - -	1 0	7 6
Cornbrash, 8½ feet.	Rock and shells - - -	2 0	9 6
	Limestone - - - -	6 6	16 0

* See also H. B. Woodward's "Memoir on Jurassic Rocks of Britain," vol. iv., p. 505, and vol. v., p. 343.

6. Spalding Waterworks—*continued*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Great Oolite Clay, 20 feet.	Hard blue clay	4 0	20 0
	Mottled clay	10 0	30 0
	Shaly clay, dark blue and green	1 0	31 0
	Hard blue rock	2 0	33 0
	Dark blue soft rock with shells	1 0	34 0
	Hard blue clay	2 0	36 0
Great Oolite Limestone, 12 feet.	Hard blue limestone	7 0	43 0
	Hard blue limestone, lighter colour	4 0	47 0
	Harder limestone, dark green	1 0	48 0
Upper Estuarine Series, 28 feet.	Dark green clay	7 0	55 0
	Hard blue rock	1 0	56 0
	Dark and light green clay	9 0	65 0
	Hard rock (with chalybeate water, level from surface 60 feet)	0 10	65 10
	Light green sandy clay	9 8	75 6
	Black clay and peat [lignite.]	0 6	76 0
Lincolnshire Limestone.	Grey porous rock (oolite limestone)	1 6	77 6
	Hard oolite limestone	33 0	110 6
	Very hard rock	5 6	116 0
	Hard limestone	5 6	121 6
	Hard oolite limestone	12 6	134 0

Messrs. Isler remark that there are no published records of springs being tapped by boring that yield a larger quantity than in this case. See *Engineering*, 24th November, 1893, p. 649.

7. Four-inch boring, at the southern end of the town, made and communicated by Mr. J. E. Noble to Mr. H. Preston. 1899. Height above O.D., 30 feet.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Drift, and Oxford Clay with Kellaways Beds	Soil	3 0	3 0
	Gravel and clay	1 0	4 0
	Clay	2 0	6 0
	Clay and sand	3 0	9 0
	Yellow sand	1 0	10 0
	Blue sand	3 0	13 0
	Clay	4 5	17 5
	Rock	3 7	21 0
	Clay	6 0	27 0
	Dicey clay	2 8	29 8

7. Four-inch boring—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Cornbrash	Rock	5 11	35 7
Great Oolite Clay 19 ft. 9 in.	Clay	16 9	52 4
	Stone and clay	1 0	53 4
	Clay	2 0	55 4
Great Oolite Limestone 7 ft. 5 in.	Rock	4 6	59 10
	Clay	0 6	60 4
	Rock	2 5	62 9
Upper Estuarine Series 33 ft.	Hard clay	4 0	66 9
	Clay and stone	2 0	68 9
	Clay	5 8	74 5
	Rock	2 0	76 5
	Clay	19 4	95 9
Lincolnshire Limestone	Soft rock	3 0	98 9
	Rock	5 3	104 0

8. About middle of town.

Two-inch boring made and communicated by Mr. J. E. Noble to Mr. H. Preston. 1900. Height above O.D., 30-ft,. Water overflows.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil		2 0	—
Drift	Clay	7 0	9 0
Cornbrash	Rock	5 1	14 1
Great Oolite Clay	Clay	21 0	35 1
Great Oolite Limestone 13 ft. 11 in.	Rock	8 3	43 4
	Clay	3 8	47 0
	Rock	2 0	49 0
Upper Estuarine Series 27 ft. 8 in.	Clay	7 0	56 0
	Rock	1 0	57 0
	Clay	19 8	76 8
Lincolnshire Limestone	Rock	19 3	95 11

9. At the Red Lion Hotel.

Made and communicated by Mr. J. E. Noble. 1901.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Drift and Oxford Clay	Soil and stone	3 0	3 0
	Clay	1 0	4 0
	Sand	1 0	5 0
	Clay	8 0	13 0
Cornbrash	Rock	5 2	18 2
Great Oolite Clay	Clay	21 10	40 0

9. At the Red Lion Hotel—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Great Oolite Limestone 12 ft. 10 in.	Rock	7 7	47 7
	Clay	3 3	50 10
	Rock	2 0	52 10
Upper Estuarine Series 26 ft. 9 in.	Clay	5 8	58 6
	Rock	1 0	59 6
	Clay	13 3	72 9
	Clay Bind	6 10	79 7
Lincolnshire Limestone	Rock	18 5	98 0

10. Stamford Hill, at the junction of Stamford Road with Colsterworth Road.

Made and communicated by Mr. J. E. Noble to Mr. H. Preston. 1898.

Height above O.D., 134 feet; water level, 85 feet below surface; yield, a plentiful supply.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay and Kellaways Beds	Clay	44 0	—
	Blue sand	9 4	53 4
	Clay	11 8	65 0
Cornbrash	Rock	6 2	71 2
Great Oolite Clay	Clay	20 4	91 6
Great Oolite Limestone	Rock	8 11	100 5
Upper Estuarine Series. 35 ft. 8 in.	Clay	11 0	—
	Rock	1 0	—
	Clay	23 8	136 1
Lincolnshire Limestone	Rock	28 3	—
	Clay	1 6	—
	Rock	59 6	225 4

11. Cawthorpe, 1½ miles N. of Bourn.

Four-inch boring to depth of 110 feet. Water rose 12 feet above surface.

J. Addy, *Proc. Inst. C.E.*, lxxiv. (1883), 160.

12. Dyke, 2 miles N. of Bourn.

Two-inch boring to depth of 78 feet. Water rose above surface.

J. Addy, *Ibid.*

13. Bourn Eau, 1⅝ miles E. of Bourn.

From specimens seen by Mr. A. J. Jukes-Browne, and information from Mr. Kirkby, G.N.R.

		Ft.
Fen Beds	Soft clay	26½
	Peat	½
	Silty clay	1½
Boulder Clay	Hard grey clay with chalk pebbles	at 28½
	Hard blue clay without stones	at 29½
	Hard clay, full of stones and sand	30½
	Marly clay with chalk pebbles	30½ to 31½
Kellaways Beds	Hard shaly clay from	33–36
	Stone	4 inches
	Very hard clay	at 37
	Hard shaly clay	from 38 to 43
Cornbrash	Blue rock	—

14. Two-inch boring at Bourn Fen, 1½ miles east of Bourn alongside of railway.

(1 in. Map, N.S., 144; 6 in. Map 141 N.W.)

Made by Mr. J. E. Noble. Date, 1897.

Communicated by Mr. Henry Preston.

Height above O.D., 10 feet; water overflows; yield, 10,000 gallons per hour.

———		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil and turf	13	0	—	
Oxford Clay	Clay	32	6	45	6
Cornbrash	Rock	8	6	54	0
Great Oolite Clay	Clay	15	0	69	0
Great Oolite Limestone 15 ft.5 in.	Rock	2	0	71	0
	Clay	4	0	75	0
	Rock	9	5	84	5
Upper Estuarine Series 36 ft. 0 in.	Clay	4	0	88	5
	Rock	1	0	89	5
	Clay	31	0	120	5
Lincolnshire Limestone	Rock to	9	0	129	5

15. Four and a half inch boring at Twenty, 1¼ miles N.N.E. of Twenty Station

(1 ft. 6 in. Map, N.S., 144; 1 ft. 6 in. Map 141 N.W.)

Made by Mr. J. E. Noble. 1900.

Communicated by Mr. Henry Preston.

Height above O.D., 9 feet; water overflows; yield, 7,000 gallons per hour.

———		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil		1	0	1	0
Drift	Clay	3	0	4	0
	Sand	21	0	25	0
Oxford Clay and Kellaways Beds	Clay	38	8	63	8
	Sand	10	0	73	8
	Clay	8	4	82	0

15. Four and a half inch boring—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Cornbrash	Rock	7 0	89 0
Great Oolite Clay	Clay	22 9	111 9
Great Oolite Limestone	Rock	9 6	121 3
Upper Estuarine Series	Grey Marl	12 0	133 3
Lincolnshire Limestone	Rock	27 0	160 3

16. Two-inch boring, two-thirds of a mile north of Twenty Station. Made by Mr. Noble in 1900. Communicated by Mr. H. Preston. Height above O.D. 8 feet; yields about 6,000 gallons per hour, overflow.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil		0 6	0 6
Alluvial and Drift Deposits	Clay	9 6	10 0
	Turf (peat)	3 0	13 0
	Clay	5 0	18 0
	Grey Sand	3 0	21 0
	Gravel	3 0	24 0
Oxford Clay and Kellaways Beds	Clay	41 0	65 0
	Hard Sand	13 0	78 0
	Clay	8 0	86 0
Cornbrash	Rock	5 6	91 6
Great Oolite Clay	Clay	20 6	112 0
Great Oolite Limestone	Rock	10 6	122 6
Upper Estuarine Series	Clay	21 0	143 6
	Grey Marl	14 0	157 6
Lincolnshire Limestone	Rock	51 6	209 0

17. At Bourn Fen, nearly 1 mile N.E. of Twenty Station. (1 in. Map, N.S. 144; 6 in. Map 141 N.W.)

Made and communicated by Mr. J. E. Noble to Mr. H. Preston. 1901. Height above O.D., 7 ft.; water overflows; yield, 8,000 gallons per hour.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay and Kellaways Beds	Clay	93 0	93 0
	Sandy Rock	10 0	103 0
	Clay	9 0	112 0
Cornbrash	Hard Rock	7 9	119 9
Great Oolite Clay 17 ft. 9 in.	Clay	12 9	132 6
	Rock	1 0	133 6
	Clay	4 0	137 6
Great Oolite Limestone 13 ft.–2 in.	Rock	10 2	147 8
	Clay	2 0	149 8
	Rock	1 0	150 8
Upper Estuarine Series 31 ft.–0 in.	Clay	17 0	167 8
	Marl	14 0	181 8
Lincolnshire Limestone	Rock	43 4	225 0

18. Boring at Tongue End Farm, about 5 miles E.S.E. of Bourn.

(1 in. Map 64, N.S., 144; 6 in. Map 141, S.E.)

Communicated by Mr. Edward Easton, C.E., 1894.

Water found at a depth of 190 feet and rose to 60 feet above surface.

——		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvium and Oxford Clay	Blue clay	50 0	50 0
	Hard brown clay	46 0	96 0
Kellaways Beds	Hard sandstone	10 0	106 0
	Blue clay	10 0	116 0
Cornbrash	Hard stone	7 6	123 6
Great Oolite Clay	Clay	17 0	140 6
Great Oolite Limestone	Hard stone	13 6	154 0
Upper Estuarine Series	Clay	11 0	165 0
	Stone	1 0	166 0
	Hard brown clay	7 0	173 0
	Clay, stones, and a bed of Shells	10 0	183 0
Lincolnshire Limestone	Hard stone like Granite	15 0	198 0

See also Analyses, p. 200.

Braceborough.

(1 in. Map 64, N.S., 157; 6 in. Map 146 N.E.)

1. For Water Supply of Peterborough.

John Addy, *Proc. Inst. Civ. Eng.*, lxxiv. (1883), 150.

1. Boring "about 30 yards from the stream, a branch of the Glen, and at about 110 yards in its course below the Spa."—1875.

Water rushed up in large volumes to 15 feet above the surface. Yield from 4 inch bore at rate of 420 gallons per minute.

——	Thickness.	Depth.
	Ft. in.	Ft. in.
Surface soil, alluvial gravel, and clay	16 0	16 0
Estuarine bed	12 0	28 0

2. Boring 600 yards to N.E. of No. 1, and about 30 feet from present well. To the "Water Rock," and abundant supply proved.

3. Well, 1877.

Sunk to surface of "Water Rock," 50 feet.

Reservoir constructed on Obthorpe Hill, at height of 160·2 feet above O.D.

2. Made and communicated by Mr. J. E. Noble, Thurlby, 1896. 1½-inch boring. Height above O.D., 54 feet; water at ground level; yield, a good village supply.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Drift, 21 ft.	Sand	1 0	—
	Clay	13 0	14 0
	Sand	7 0	21 0
Oxford Clay	Clay	12 4	33 4
Cornbrash	Rock	6 7	39 11
Great Oolite Clay 20 ft. 11 in.	Clay	12 5	52 4
	Rock	1 6	53 10
	Clay	7 0	60 10
Great Oolite Limestone	Rock	10 1	70 11
Upper Estuarine Series	Clay	44 6	115 5
Lincolnshire Limestone	Rock	8 0	123 5

See also Analyses, p. 201.

Bracebridge.

(1 in. Map 83, N.S., 114; 6 in. Map 70 S.W.)

Trial bore made by Messrs. Le Grand and Sutcliff for Messrs. Bass & Co. Communicated by C. E. De Rance, *Proc. Yorksh. Geol. Soc.*, xii., 49.

Yield, saline water.

	Thickness.	Depth.
	Ft. in.	Ft. in.
Lower Lias Clay	320 0	320 0

See also Analyses, p. 20.

Brocklesby.

(1 in. Map 86, N.S., 90; 6 in. Map 21 N.W.)

Brocklesby Hall.

Communicated by Mr. Westaby.

	Ft
Sand	9
Clay	21
To Chalk	30

Brigg.

(1 in. Map 86, N.S., 89; 6 in. Map 19 S.E.)

Record of a boring made on the south side of Bridge Street, at a distance of 70 yards west of the River Ancholme, by Mr. Joseph Parker, in 1864–5. At the depth of 84 feet water rose nearly to the surface. Communicated by Mr. A. Atkinson, of Brigg, to Mr. Ussher.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvium	Vegetable soil and clay, loose	40 0	40 0
Oxford Clay and Kellaways Beds	Blue shale	42 0	82 0
	Sandstone rock	2 0	84 0
	Blue shale	18 0	102 0
Cornbrash	Limestone rock	3 0	105 0
Great Oolite Clay	Blue shale	24 4	129 4
Great Oolite Limestone 11 ft. 7 in.	Sandstone rock	0 9	
	Grey shale	1 6	
	Hard rock or boulder	0 6	
	Grey shale	0 11	
	Rock	1 1	
	Unformed rock	6 10	140 11
Upper Estuarine Series 24 ft. 2 in	Grey shale	2 10	
	Sandy shale	10 5	
	Sand	10 11	165 1
Lincolnshire Limestone 44 ft. 7 in.	Limestone rock	1 8	
	Parting or fissure	0 6	
	Limestone	2 6	
	Parting	0 2	
	Limestone rock	4 6	
	Shale	1 0	
	Limestone rock, with fissures	34 3	209 8
Lower Estuarine Beds and Upper Lias	Blue shale	108 5	318 1
Middle Lias	Limestone rock and fissures	11 10	329 11
	Blue shale	21 0	350 11
	Limestone rock	0 6½	351 5½
	Blue shale	12 9½	364 3

Brinkhill.

(1 in. Map 84, N.S., 115; 6 in. Map 74 N.E.)

At cottage in chalk quarry half a mile S.S.E. of Church. Information obtained by Mr. Jukes-Browne.

		Ft.
Chalk, 28 feet.	Rough white chalk	16
	Red chalk, dark at the bottom	12
Carstone, 34 feet.	Greyish-white soapy clay	4
	Red and brown sands	30
		62

Broughton.

(1 in. Map 86, N.S., 89 ; 6 in. Map 19 S.W.).

Wells sunk on Broughton Carrs, three-quarters of a mile south-east of Old Decoy, 50 yards apart.

Information supplied by Mr. Cressey, of Scunthorpe, (well-sinker), to Mr. Ussher.

	Ft.	in.
Peat	0	9
Blue clay	20	0
Tough, light-coloured, silty clay, about	6	0
Harder clay, rather peaty	5	0
	31	9
Peat	0	9
Blue clay	21	0
Gravel (spring)	8	0
	29	9

Brumby, Crosby, Frodingham and Scunthorpe.

Dr. D. A. Gresswell in 1885 (Report to Local Government Board) remarked that the wells " vary in depth from 7 to 18 feet. The soil at Frodingham and Scunthorpe for a depth of 2 or 3 feet is sandy, and contains 80 per cent. of silica and 20 per cent. of lime, organic matter, and iron ; a thin layer rich in peroxide of iron follows, and then a hard stratified rock of some depth, and consisting of ferruginous limestone, beneath which there lies a blue shale. The wells are sunk into the stratified limestone. . . . A very large number of them ran dry last summer, and the greatest difficulty was experienced in obtaining water." Iron is generally present in the water.

(In this Report Brumby is spelt Bromby.)

Brumby.

(1 in. Map 86, N.S., 89 ; 6 in. Map, 18 N.E.).

Communicated by Mr. Cressey, (well-sinker), to Mr. W. A. E. Ussher.

Well at the cross roads by the new house on Brumby Common, near Brumby Grove.

	Feet.
Sand	30
Peat bed	about 20
Rhætic ? Clay (not penetrated in sinking)	about 20

Burgh-le-Marsh.

(1 in. Map 84, N.S., 116 ; 6 in. Map 83 N.E.)

1. Well near the Church.

Information obtained in the town.

	Ft.
Glacial Drift—Soft sand	20

2. At the farm about a mile S.S.E. of the Church.
Information from Mr. Bland (tenant).

		Ft.
Alluvium	Soil and silty clay	6
Glacial Drift	Marly clay, with chalk-stones	5
	Gravel and sand, with water	1
		12

3. In a field about half-way from the station to the town.
Communicated by Mr. J. Bingley, of Aby (well-sinker).
Dug 15 feet, bored 42 feet.

		Ft.
Glacial Drift	Clay, with stones	31
	Sand	4
	Clay, with stones	20
	Gravel	2
		57

4 At Mr. Thornally's farm, one mile N.E. of Church.
Communicated by Mr Jabez Good, of Burgh.
No good water found.

		Ft.
Alluvium 10 feet.	Soft brick clay	8
	Peat, with large oak trees	2
Glacial Beds 48 ft.	Light-coloured clay, with small chalk-stones	18
	A spring of salt water at this depth.	
	Liver-coloured clay, mixed with gravel and sand	30
	A second spring of salt water (? in gravel).	
Kimeridge Clay	Blue clay, very dry, containing Ammonites	154
		212

5. Cottage near Fawker's House, half a mile N.E of Church.
Information obtained on the spot.
Water rises to the surface.

		Ft.
Alluvium	Yellow sandy silt	about 6
Glacial Drift	Bluish marly clay, with stones	,, 25
	Sand and small gravel	,, 2
		33

Burton (by Lincoln).

(1 in. Map, N.S., 102; 6 in. Map 61, S.W.)

1. Middle Low Field.

Communicated by Mr. Watkins. Lincoln, to Mr. Cameron.

	Ft.
Gravelly top soil.	
Blue shale (Lias)	60

Burton Flats. Evans Farm Steading.

	Ft.
Sand with water	10

Cabourne.

(1 in. Map 86, N.S., 90 ; 6 in. Map 29 S.E.)
At the farm one mile north-east of the Church.
Information supplied to Mr. Clement Reid by Mr. Hopkins.

	Ft.
Chalk, to gravel (Carstone)	162

Calcethorpe (Calsthorpe)—*see* Kelstern.

Cadney.

(1 in. Map 86, N.S., 89 ; 6 in. Map 28 N.W.)
At the Manor House, Cadney.
Communicated by Mr. H. Preston, from information supplied by Rev. E. A. Woodruffe-Peacock, F.G.S.
Sunk 36 feet, the rest bored.
No water.

		Ft.	in.	Ft.	in.
Gravel	Sand and soil	0	5	0	5
	Gravel and sand, mean depth	4	3	4	8
	Large gravel in matrix of sand, iron-stained	4	0	8	8
Boulder Clay	Chalky boulder clay (locally called "Chalk-marl")	2	3	10	11
	Blue boulder clay with a little chalk	13	0	23	11
	Blue clay	2	0	25	11
	Chalky boulder clay	2	0	27	11
	Boulder clay (large and small boulders)	2	6	30	5
	,, ,, (with fossils)	5	6	35	11
	,, ,, ("Chalk pudding")	1	6	37	5
Oxford Clay	("Mother bed")	42	7	80	0

"No other well in the immediate neighbourhood has reached Boulder Clay, there always being a good supply of water from the first 30 feet of sandy gravel.—E. A. W.P.

Caistor.

(1 in. Map 86, N.S., 89 ; 6 in. Map 28 S.E.)
Well and boring near the Old Mill, 1903.
Communicated by Mr. Henry Preston.

"At a depth of 40 feet a bed of Chalk was encountered, the previous bore having been through sandy soil. On Tuesday, September 8th, water was struck, the well being then 90 feet deep, but as the flow of water was deemed insufficient boring was continued, and on Saturday morning, at a depth of 100 feet, a spring was reached which yielded 7,800 gallons per hour. The water appears to be of excellent quality.

Canwick.

(1 in. Map 83, N.S., 114 ; 6 in. Map 70 S.E.)
Lincoln Sewage Outfall Works. Noted by Mr. Penning.

	Ft.	in.
Peat	1	6
Clean sand (with bones)	12	6
Fine gravel or silt	3	0
Hard sandy clay	2	6
Coarse quartzite gravel	8	0
	27	6

Carlton, Great.

(1 in. 84 Map, N.S., 104 ; 6 in. Map 57 N.W.)

Communicated by Mr. J. Bingley, of Aby (well-sinker).

Dug 18 feet, bore 66 feet.

	Ft.
[Boulder Clay] Clay	69
Sand	3
[Chalk] Rock	12
	84

Caythorpe.

(1 in. Map 70, N.S., 127 ; 6 in. Map 96 S.W.)

1. Ironstone Mines.

Communicated by Mr. W. Burke, Superintendent.

		Ft.	in.
Lower Lias	Ironstone	10	0
	Grey limestone	3	6
	Blue binds with shreds of rocks	46	0
	Hard green rock	0	9
	Blue binds with shreds of rock	67	9
	Blue binds	183	0

2. Railway station.

Information from Mr. Joseph Cocks.

	Ft.
Shelly rock and blue rock	—
[Marlstone] With " kale " at bottom	24

3. Boring about one-third mile east of Caythorpe Court.

Made by Mr. J. E. Noble, Thurlby. 1902.

Sunk 46 feet, the rest bored (6 inches diam.).

Communicated by Mr. H. Preston, *Quart. Journ. Geol. Soc.*, vol. lix., 29.

Height above O.D., 320 feet ; water level, 175 feet from surface.

——		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Surface Deposits	Soil	1	0	1	0
	Sand and yellow clay	3	6	4	6
Northampton Sands	Ferruginous limestone	4	6	9	0
Upper Lias	Blue clay, with layers of concretionary nodules	199	6	208	6
Marlstone	Dark greenish-blue limestone	19	6	228	0
Middle Lias Clays	Hard silty clay, greenish in colour, sandy and micaceous ; to	3	6	231	6

Chapel St. Leonards.

(1 in. Map 84, N.S., 116 ; 6 in. Map 76 N.E.)

1. At Mr. Hodgson's.

Communicated by Mr. Th. Newton, of Anderby (well-sinker).

Dug 9 feet, bored the rest.

	Ft.
[Post-glacial] Clay	9
[Boulder Clay] Marl	60
Sand and gravel	10
Chalk	12
	91

2. At Mr. Rennie's, Chapel Bank.

Communicated by Mr. Th. Newton, of Anderby.

Dug 12 feet, bored the rest.

	Ft
Sand and clay	12
[Boulder Clay] Marl	54
Sand	10
Chalk	8
	84

Claythorpe.

(1 in. Map 84, N.S., 104 ; 6 in. Map 66 N.W.)

1. At the railway station. Sunk in 1877.

Communicated by Mr. Ch. Kirkby, of Great Northern Railway Company, Louth.

	Ft.
Hard blue clay	12
Clean sharp sand, full of water	5
Hard clay	14
Dirty sand, full of water	6
	37

2. Near the railway station.

Communicated by Mr. J. Bingley, of Aby (well sinker).

Dug 30 feet, bored 36 feet.

	Ft.
Through clay (60 feet), into gravel (6 feet)	66

Mr. Bingley states that this well was dug at the junction of the sand and clay, one side of the well being sand and the other clay for a depth of 28 feet, a very curious arrangement.

Claxby.

(1 in. Map 84, N.S., 116; 6 in. Map 75 N.W.)

1. Acre House Mine.

Prof. J. W. Judd, *Quart. Journ. Geol. Soc.*, xxvi., 331, 1870.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil		2 6	2 6
Chalk	White chalk	9 ft. to 10 ft.	12 0
[Red Chalk]	Beds of yellow clay and red marly chalk	10 0	22 0
[Carstone]	Red sand	10 0	32 0
[Tealby Limestone]	Limestone rock, hard and blue-hearted	14 0	46 0
[Tealby Clay]	Blue clay		
[Claxby Ironstone]	Ironstone, soft and earthy above, solid and finely oolitic below	13 to 14 ft.	59 6
[Spilsby Sandstone]	Coarse greenish-white sands, in places indurated into hard sandstone rock	6 to 7 ft.	66 0
Kimeridge Clay	Very dark-coloured, highly bituminous shaly clay. A thin bed at the top is remarkable for its highly inflammable character.		

2. Farm at south end of Shaddy's Walk, one mile from the Church.

Information from the occupier.

	Ft.
Through white chalk into red rock	108

3. Well at the Rectory, close to the Church.

Inofrmation from Mr. Tyson (well-sinker), of Willoughby.

Found a supply of water.

	Ft.
Chalk in original well	66
Chalk bored by Tyson	15
	81

4. Mr. Wright's farm, two furlongs E.N.E. of Church.

Communicated by Mr. Tyson (well-sinker), of Willoughby.

	Ft.
Clay [Boulder Clay]	46
Sand, with water	2
Clay	9
Sand, with strong spring	3
	60

Cleethorpes.

(1 in. Map 85, N.S., 90 ; 6 in. Map 23 S.W.)

1. North end of the cliff, and close to the pier.

From Mr. Penning's notes.

See also under Grimsby,- p. 104.

	Ft
Boring into the Chalk	204

Formerly yielded 200 gallons in five minutes. The water overflows 2 feet above the surface. [The supply is now much smaller.]

2. Pier (from half tide).

Communicated by Mr. John Smith.

	Ft.
Marly clay Soft white Chalk with flints.	60

One boring at Cleethorpes was sunk 45 feet in soft Chalk.

3. At the Gas tank.

Communicated by Mr. Joseph Jackling.

	Ft.
Warp about	20
[Boulder Clay] Clay, with vein of sand 1½ yards thick at 15 yards	72
Sand	2
To Chalk about	94
Chalk (soft like putty)	39
	133

4. At first Brick-yard on the Humber Shore, W. of the village.

	Ft.
Clay, to Chalk	120

5. In the bed of the Humber, 400 yards below high-water mark.

Communicated by Mr. T. W. Wallis, to Mr. Jukes-Browne. Yield, 100 gallons per minute, forcing a jet 16 feet higher than the ground.

	Ft.
Rock at	72
In Chalk	21

Coates, Great.

(1 in. Map 86, N.S., 90 ; 6 in. Map 22 N.W.)

Mr. Cordeaux's.

Communicated by Mr. Cordeaux.

	Ft.
Boulder Clay, 8 feet Sand (thick bed) Boulder Clay	66
Chalk	—

The house is about 9 or 10 feet above the marsh level. Similar sections occur all over Great Coates.

On the marshes a boring, midway between the railway and the Humber bank, made by Mr. Cordeaux in July, 1885, passed through :—

	Ft.
Clear warp with a cockle shell	12
Forest bed	2½
Whitish Clay and sand [old soil ?]	1
Chalky Boulder Clay, reddish at top, darker lower down, the lowest part not unlike the lower bed at Dimlington in colour	55 or 60
Sand and gravel	2 or 3
Chalk	—

Many of the wells at Coates are affected by the tides, the flow decreasing at neap tides, though the water is perfectly fresh.

Coates, North.

(1 in. Map 85, N.S., 90 ; 6 in. Map 31 S.W.)

1. North Coates. (Several wells.)

Communicated by Mr. Joseph Jackling.

	Ft.
Warp	60
Sand	1½
Dark stiff clay with a few stones	15 to 18
Sand with stones	½ to 3
To Hard Chalk	85

2. North Coates Fitties.

Communicated by Mr. Joseph Jackling.

	Ft.
To Chalk (rather soft)	about 84 to 90

3. Parsonage.

Communicated by Mr. Joseph Jackling.

At 11 yards down leaves and wood were found.

4. Near Tetney.

Information from a well-sinker at Louth (to Mr. Jukes-Browne).

	Ft.
Reddish clay	5
Silt and "moor"	40
Blue clay with stones	30
Sand	6
Chalk touched	2
	83

Cockerington, South.

(1 in. Map 84, N.S., 103; 6 in. Map 48 S.E.)

At Mr. Beverley's, in South Cockerington.

Communicated by J. Bingley of Aby (well-sinker).

	Ft.
Clay, with stones	18
Sand	6
Clay, with stones	60
Sand	6
Rock [Chalk]	21
	111

Coleby.

(1 in. Map 83, N.S., 114; 6 in. Map 86 N.E.)

Shaft for Ironstone.

J. Daglish and R. Howse, *Trans. N. Engl. Inst. Min. Eng.*, xxiv. (1874) plate xi. Captain Macdakin, *Geol. Mag.*, 1877, p. 407.

		Ft.	in.
[Lincolnshire Limestone]	Oolitic limestone	45	0
[Northampton Beds] 10 feet.	Peroxide bed	0	8
	Clay mixed with ironstone	0	4
	Hard blue ironstone (carbonate of iron)	0	9
	Clay parting	0	4
	Hard blue ironstone (carbonate of iron)	1	4
	Peroxidised band ("girdles")	0	1
	Soft blue ironstone	0	9
	Blue ironstone nodules with clay partings	0	11
	Blue siliceous ironstone	1	1
	Blue ironstone nodules	0	6
	Clay with nodules (micaceous)	3	0
	Coprolite-bed with pyrites	0	3
[Upper Lias]	To Blue Lias clay		
		55	0

Corby.

(1 in. Map 64, N.S., 143; 6 in. Map 131 S.E.)

1. Boring at Heath Farm, near railway station. 300 feet above O.D. About 150 gallons of water per day, obtained for a year or two; no supply now.

Communicated by Mr. H. Preston.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Lincolnshire Limestone	Hard rock	91	0	91	0
Upper Lias	Clay	39	0	130	0

2. Well near the above, 294 feet above O.D.
Measured by Mr. H. Preston, October, 1901.
Contained 2 feet of water.

	Ft.
Lincolnshire Limestone	91½
Upper Lias Clay	3
	94½

3. At Birkholme Cottages, 1 mile S.W. of Heath Farm, 265 feet above O.D.
Communicated by Mr. Preston.
Contained 1 foot of water.

		Ft.
Lincolnshire Limestone	about	35
Upper Lias Clay	about	2
		37½

Covenham.

(1 in. Map 84, N.S., 90; 6 in. Map 40 S.W.)
At Birkett's Farm, three-quarters of a mile N.E. of St. Bartholomew's Church.
Information from Mr. Birkett.
Dug 12 feet, bored about 58 feet.

	Ft.
Reddish clay with stones	30
Gravel and shingle	20
Brashy chalk, about	5
Solid Chalk	15
	70

Crosby. *See* p. 76.

Crowland.

(1 in. Map 64, N.S., 158; 6 in. Map 148, S.W.)
Section of boring N.W. of Abbey. Messrs. Hodson & Son, Engineers, 1902.
Communicated by Mr. H. Preston.
Height above O.D., 12 feet; water overflows; yield, 15,000 gallons per day at 280 feet, an additional 5,000 gallons per day at 470 feet.
Both waters very saline.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Alluvium	Surface soil	2	6	2	6
	Sand and gravel	7	0	9	6
	Coarse gravel	5	0	14	6
Boulder Clay	Soft, light-coloured clay without pebbles	7	1	21	7
	Soft white clay with pebbles	128	5	150	0
	Clay, darker, no pebbles	17	0	167	0

Section of boring N.W. of Abbey—*continued.*

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Oxford Clay	Clay; soft and with faiky-ribs, and limy	20	7	187	7
	Clay, with grey limy faikes, very hard	17	3	204	10
	Blue clay and lime balls (nodules)	3	2	208	0
Cornbrash	Hard bastard limestone	6	4	214	4
Great Oolite Series	Mixed clay	3	6	217	10
	Greenish clay	3	0	220	10
	Brown clay	2	0	222	10
	Mixed clay	12	8	235	6
	Brown clay	1	6	237	0
	Mixed clay	2	4	239	4
	Sandy marl	1	5	240	9
	Dark brown clay	3	3	244	0
	Light fine sandstone	3	3	247	3
	Fissure (Quicksand?)	0	9	248	0
	Soft clay	1	0	249	0
	Extra hard clay	1	1	250	1
Lincolnshire Limestone	Hard limy sandstone	12	3	262	4
	Hard limestone	16	3	278	7
	Limestone, very hard	8	0	286	7
Lower Estuarine Series and Northampton Sands	Soft light-coloured clay	1	1	287	8
	Soft light-coloured sandstone	5	9	293	5
	Dark clay and balls (nodules)	4	9	298	2
	Coarse brown sandstone	5	3	303	5
	Limestone	3	0	306	5
	Limy "faikes"	1	9	308	2
Upper Lias	Dark blue clay	6	11	315	1
	Limestone ball (nodule)	0	9	315	10
	Dark blue clay	93	4	409	2
	Grey clay	2	10	412	0
	Dark blue clay, hard and concretionary	31	4	443	4
Middle and Lower Lias	Clay, hard, and with ribs	17	0	460	4
	Soft and hard limestone bands	12	6	472	10
	Hard grey clay with ribs	7	6	480	4
	Hard clay with concretions	123	2	603	6

Crowle.

(1 in. Map 86, N.S., 88; 6 in. Map 17 N.W.)

Boring at the New Trent Brewery, Crowle Wharf.

		Ft.
Alluvium	Blue clay	60
Keuper Marls	Rock, water, and alabaster	2½
	Clay	15
	Rock	5
	Clay	15
	Rock	5
	Clay	15
	Rock	5
	Clay	15
	Rock	2½
	Clay	5
		145

At 145 feet water rose to within 5 feet of the surface.

Messrs. Strangways and Cameron consider that the uniformity of thickness assigned to the rock and clay beds in this section precludes reliance on the details, though the section is of importance as proving the presence of Keuper Marls so far west. The rock-beds appear to be shaly sandstones.

Cumberworth.

(1 in. Map 84, N.S., 116; 6 in. Map 76 N.W.)
At West Field Lodge, five furlongs W.S.W. of Church.
Communicated by Thomas Newton, of Anderby (well-sinker).

		Ft.
Glacial Drift	Marl and clay, with chalk	60
	Sand	6
	Gravel and "croy"	3
Chalk		12
		81

Dalby.

(1 in. Map 84, N.S., 116; 6 in. Map 75 S.W.)
1. At Froghall, one mile north of Dalby Church.
Information obtained from Mr. Riggall (tenant).

	Ft.
White Chalk	25
Red Chalk	12
Carstone—Brown sand	5
	42

2. Boring at Dalby Hall.

Made and communicated by Messrs. Le Grand and Sutcliff, 1898.
Water-level, 90 feet from surface. Yield, 500 gallons per hour.
Supply of good water obtained at a depth of 180 feet.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Roach 35 feet	Yellow clay	5 0	—
	Brown sand	5 0	10 0
	Yellow clay	5 0	15 0
	Ironstone	1 3	16 3
	Yellow clay and stone	18 9	35 0
Tealby Clay 102 feet	Blue clay and occasional claystones	84 0	119 0
	Brown sandy clay and thin bands of sandstone	8 0	127 0
	Blue clay and claystones	10 0	137 0
Spilsby Sandstone 58 feet	Sandstone	2 4	139 4
	Grey sand	20 8	160 0
	Grey sand and sandstone	4 6	164 6
	Sandstone	3 9	168 3
	Grey sand	26 9	195 0

Dalderby.

(1 in. Map 83, N.S., 115 ; 6 in. Map 81 N.W.).

Manor Farm belonging to Sir H. Dymoke.

Communicated by Mr. Dobbs of Kirkstead, well-sinker.

	Ft.
Sunk through white clay full of stones (Boulder Clay) - -	60
Bored through the same into stony bed with water - - -	30
	90

Deeping St. James.

(1 in. Map 64, N.S., 158 ; 6 in. Map 147 S.W.)

1. Boring on Marquis of Exeter's Estate, 1896.

Communicated by Mr. H. Sykes, 66, Bankside, London.

Water rises 31 feet above ground. Level of ground about 10 feet above O.D

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Drift	Clay and gravel - - -	16	6	16	6
	Clay and sand - - -	1	6	18	0
Kellaways Beds	Shaly rock - - - -	10	0	28	0
	Blue clay - - - -	6	0	34	0
Cornbrash	—Hard "granite" rock - -	9	0	43	0
Great Oolite Clay	Sandy clay - - - -	1	0	44	0
	Shaly rock with shells - -	1	0	45	0
	Hard mottled clay - -	10	0	55	0
	Shaly rock - - - -	3	0	58	0
	Hard brown clay - -	2	0	60	0
	Clay and shells - - -	1	0	61	0
Great Oolite Limestone	Very hard shaly rock - -	13	0	74	0
Upper Estuarine Series	Shelly clay - - - -	32	0	106	0
Lincolnshire Limestone	Oolite rock - - - -	14	0	120	0

2. Well.

	Thickness.	Depth.
	Ft. in.	Ft. in.
Soil	3 0	3 0
Gravel	10 0	13 0
Boulder clay		

Deeping St. Nicholas.

(1 in. Map 64, N.S., 144; 6 in. Map, 147, N.E.).

Boring at Littleworth, about ¼ mile south-west of church. 1894. Height above O.D. about 10 feet. Sunk 5 feet 6 inches, the rest bored. Completed November 26th, 1894.

Communicated by Mr. Henry Sykes, 66, Bankside, London.

Water rose 2 feet above ground; yield, 20 gallons per minute.

Saline water was noted at 264 feet.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvial Deposits	Clay and silty sand	15 0	15 0
	Peat	1 0	16 0
	Brown clay	2 0	18 0
	Peat	2 0	20 0
	Gravel	3 0	23 0
Oxford Clay and Kellaways Beds	Blue clay	130 0	153 0
	Clay and shells	50 0	203 0
	Shaly rock	7 0	210 0
	Blue clay	16 0	226 0
Cornbrash	Hard sandstone [limestone]	7 0	233 0
Great Oolite Clay and Limestone	Mottled clay and shells	10 0	243 0
	Hard blue rock with a little water	10 0	253 0
	Brown clay	7 0	260 0
	Sandstone rock	3 0	263 0
Upper Estuarine Series	Clay and shells	22 0	285 0
Lincolnshire Limestone	Freestone rock: Water struck at 286 feet and 308	42 0	327 0
	Pipe clay	1 0	328 0
Lower Estuarine Series (?)	Soft sandstone rock: More water at 332	20 0	348 0
	Sandy clay	2 0	350 0

In this account it is not easy to separate the Great Oolite beds into a clay and a limestone group, and the two together are rather thinner than usual (only thirty feet). See also record of boring at Crowland.

Deeping, West.

(1 in. Map 64, N.S., 157 ; 6 in. Map 151 N.E.)

Boring at Vicarage.

Made by Mr. J. E. Noble, Thurlby, Bourn. Date, 1900.

Communicated by Mr. Henry Preston.

Height above O.D., 40 ft. Water overflows. Yield, very satisfactory

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	1 0	1 0
Drift	Stone	3 0	4 0
	Gravel	10 3	14 3
	Clay	12 0	26 3
Cornbrash	Rock	5 6	31 9
Great Oolite Clay	Clay	18 0	49 9
Great Oolite Limestone	Rock	1 6	51 3
	Clay	1 0	52 3
	Rock	14 5	66 8
Upper Estuarine Series	Clay	33 4	100 0
Lincolnshire Limestone	Rock	20 10	120 10

Denton.

(1 in. Map 70, N.S., 143 ; 6 in. Map 122 N.W.).

The Hall.

Information obtained by Mr. W. H. Holloway from the well-sinker.

		Ft.	in
	Soil	2	6
Marlstone	Rubble	2	0
	Shelly checkery stone (with fossils "Jacks")	4	0
	Hard brown rock	7	0
Middle Lias Clays	Blue marly clay with two bands of stone each about eighteen inches thick	7	0
	Ironstone	1	0
	Blue marly clay	8	6
		3	0

Digby.

(1 in. Map 70, N.S., 114 ; 6 in. Map 87 S.E.)

1. Boring N.E. of church for the Sleaford Rural District Council. Made by Mr. J. E. Noble, 17th September, 1901. Communicated by Mr. Jesse Clare.

No water.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay and Kellaways Beds	Soil and clay	2 6	2 6
	Rock	2 9	5 3
	Sandy clay	11 9	17 0
Cornbrash	Sandy clay and stone	3 0	20 0
Great Oolite Clay, 16 feet 6 inches	Sand and clay	7 0	27 0
	Dark sand	2 6	29 6
	Light grey sand	1 6	31 0
	Clay	5 6	36 6
Great Oolite Limestone, 22 ft. 3 in.	Rock	14 5	50 11
	Stone and clay	4 0	54 11
	Rock	3 10	58 9
Upper Estuarine Series, 18 ft. 3 in.	Clay	5 9	64 6
	Hard sand	0 6	65 0
	Clay	12 0	77 0
Lincolnshire Limestone, 95 ft. 2 in.	Rock	57 5	134 5
	Clay	1 0	135 5
	Rock	36 9	172 2
Lower Estuarine Beds and Northampton Sands 7 ft. 6 in.	Clay	6 6	178 8
	Rock	1 0	179 8
Upper Lias	Clay	14 4	194 0

2. Boring.

Made and communicated by Mr. J. E. Noble. October, 1901.

Yield, 17,000 gallons per twenty-four hours. Water rises 8 feet above ground.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay and Kellaways Beds.	Soil and stone	3 0	3 0
	Rock	1 3	4 3
	Clay	0 6	4 9
Cornbrash	Rock	2 6	7 3
Great Oolite Clay	Clay	28 9	36 0
Great Oolite Limestone	Rock	15 1	51 1
	Clay	1 4	52 5
	Clay and stone	3 4	55 9
	Rock	2 6	58 3
Upper Estuarine Series	Clay	17 9	76 0
Lincolnshire Limestone	Rock	19 7	95 7

Donna Nook.

(1 in. Map 85, N.S., 91 ; 6 in. Map 32 S.W.)

Communicated by Mr. W. Sargent.

	Ft.
Silt (blowing)	30 or 33
Black mud	21
Clay and sand	60
To Chalk about	112

Donington.

(1 in. Map 70, N.S., 128; 6 in. Map 116 S.E.)

Boring at Vicarage.

Communicated by Mr. H. Preston, from "Fens of South Lincolnshire," by W. H. Wheeler.

		Thickness.		Depth.	
		Ft.	In.	Ft.	in.
[Alluvium]	Top soil and silt	25	0	25	0
	Gravel	0	6	25	6
[Boulder Clay and Oxford Clay]	Clay with chalk stones	154	6	180	0
[Kellaways Beds ?]	Blue Rock	4	0	184	0
	Clay	4	0	188	0
[Cornbrash ?]	Rock	11	0	199	0
[Great Oolite Clay and Limestone.]	Clay	13	0	212	0
	Rock	16	0	228	0
[Upper Estuarine Series.]	Clay with fetid vegetable matter (Bear's muck)	35	0	263	0

[Grouping by H. B. W.].

Donnington-on-Bain. *See* Benniworth.

Dorrington.

(1 in. Map,70, N.S., 127 ; 6 in. Map 98 N.W.)

Communicated by Mr. Jesse Clare, of Sleaford.

1. Boring at Fox's Farm, Dorrington Fen, 1896. Water came at 150 feet and rose above surface.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Alluvium	Clay	26	0	26	0
Oxford Clay and Kellaways Beds	Dice [shaly clay]	29	6	55	6
	Dice and silt	4	6	60	0
	Dice	7	0	67	0
	Rock	2	4	69	4
	Clay	3	0	72	4
Cornbrash	Rock	2	8	75	0
Great Oolite Clay	Clay	26	1	101	1

1. Boring at Fox's Farm—*continued*.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Great Oolite Limestone	Rock, mostly hard	9	8½	110	9½
	Rock with clay bands	2	0	112	9½
	Rock with clay bands	2	2½	115	0
Upper Estuarine Series	Clay	5	0	120	0
	Rock, very hard	1	9	121	9
	Clay	11	11	133	8
	Clay and dice	6	3	139	11
Lincolnshire Limestone	Soft rock	4	2	144	1
	Hard rock	9	8	153	9

2. For Brick Company, ½ mile south of village. (6 in Map 97 N.E.)
Communicated by Mr. Jesse Clare to Mr. H. Preston.
Depth 130 feet; just into Lincolnshire Limestone.

Driby.

(1 in. Map 84, N.S., 103; 6 in. Map 65 S.E.)
At the High Barn, one mile east of village.
Communicated by Mr. J. Bingley, of Aby (well-sinker).

The original well was dug to a depth of 67 yards. Mr. Bingley cleared out 25 yards of rubbish from the bottom of this, and then bored further.

		Ft.
Chalk.	White chalk	190
Red Chalk.		11
Carstone.	Greenish sand	15
Tealby Beds, 120 feet.	Hard shaly roach	21
	Brown sand	3
	Shaly roach, with beds of ironstone	73
	Ironstone	4
	Sand and water	4
	Black shaly mud or clay, with a layer of coaly matter 7 inches thick, about	15
		336

Dowsby.

(1 in. Map 70, N.S., 143; 6 in. Map 124 S.E.)

1. Communicated by Messrs. Barnes & Sharpe, Sleaford.
Water to within 6 feet of surface).

		Ft.
Drift (?)	Soil	3
	Yellow clay	8
	Blue sand	14
Cornbrash	Rock	5
Great Oolite Clay	Clay	21
Great Oolite Limestone	Rock	10
Upper Estuarine Series	Clay	33
Lincolnshire Limestone	Rock	29
		123

2. Communicated by Mr. H. Preston.

Boring at the Hall was re-tubed by Mr. Noble who measured the total depth as 136 feet. On 11th July, 1903, it was overflowing 1500 gallons per hour.

[Through Drift, Cornbrash, &c., probably to Lincolnshire Limestone.]

Dry Doddington. *See* p. 202.

Dunholme.

(1 in. Map, N.S., 102; 6 in. Map 62 N.W.)

Boring on west side of village.

Communicated by C. E. De Rance, *Proc. Yorksh. Geol. Soc.* xii.

Water rose 5 feet above surface; yield, 20,000 gallons in twenty-four hours

	Thickness.	Depth.
	Ft.	Ft.
Cornbrash	5?	5?
Great Oolite Clay	25?	30?
Great Oolite Limestone	15?	45?
Estuarine Beds	35?	80?
Lincolnshire Limestone	26?	106?

Dunsby.

(1 in. Map, N.S., 143; 6 in. Map 132 N.E.)

1. Boring at Dunsby Fen.

Made by Mr. J. E. Noble, Thurlby, Bourn, 1902.

Communicated by Mr. H. Preston.

Water tapped at 171 ft. 8 in.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	2 0	—
Drift	Sand	15 0	17 0
Oxford Clay	Clay	53 0	70 0
and	Hard sand	9 0	79 0
Kellaways Beds	Clay	10 4	89 4
Cornbrash	Rock	6 2	95 6
Great Oolite Clay	Clay	18 0	113 6
Great Oolite Limestone	Rock	9 10	123 4
Upper Estuarine Series	Clay	28 6	151 10
	Grey marl	11 6	163 4
Lincolnshire Limestone	Rock	13 4	176 8

2. At farm on Charterhouse Estate about 50 yards from the Forty-foot Drain, Dunsby Fen.

J. Addy, *Proc. Inst. Civ. Eng.*, vol. lxxiv., p. 161.

Water rose above surface.

		Ft.
Fen Beds	Quicksand	21
[Oxford Clay]	Blue clay	47
[Cornbrash]	Rock	10
[Great Oolite Clay, 33½ feet]	Blue clay	10
	Rock	11½
	Blue and mixed clay	12
[Great Oolite Limestone]	Rock	18
[Upper Estuarine Series, 32 feet]	Green clay	3
	Light-coloured clay	5
	Kale	4
	Blue clay	20
	Green clay	5
	Black peat	3
[Lincolnshire Limestone]	Rock	3
		170½

3. Boring at Dunsby Hall.

J. Addy, *loc. cit.*

		Ft.
	Soil and clay	6
[Cornbrash]	Rock	4
[Great Oolite Clay]	Blue clay	46
[Great Oolite]	Rock	14½
[Upper Estuarine Clays]	Blue, green, and black peat [*i.e.*, soft clays]	35
[Lincolnshire Limestone]	Kale	7
		112½

Other borings at Dunsby mentioned by Mr. Addy were carried to depths of 105 and 120 feet, and water rose 7 to 9 feet above the surface.

Eastoft.

See p. 202.

Eastville.

(1 in. Map 69, N.S. 115; 6 in. Map 91 S.W.)

Boring made for Mr. M. Staniland.

Communicated by Mr. A. J. Jukes-Browne.

	Ft.
Fen beds	about 20
Blue clay, with cockle shells	
Fen beds, with tree trunks	about 80
Boulder clay	
	100

Elkington, North.

(1 in. Map 84, N.S., 103; 6 in. Map 47 N.E.)

At the farm formerly held by Mr. Kemp, near Boswell.

Communicated by Mr. Charles Wilkinson, of Louth (well-sinker).

	Ft.
Bored through white chalk and "greystone" into red chalk -	297

Epworth.

(1 in. Map, N.S., 88; 6 in. Map, 25 N.E.)

"There are many wells in Epworth; those in the lower part of the town, to the west especially, are seldom used for drinking purposes, the water being very hard and sometimes discoloured. Very generally rain water is used instead. . . . There are two public wells in Epworth sunk in the rock towards the higher part of the town, their depth being about 30 feet." *

Firsby.

(1 in. Map 84, N.S., 116; 6 in. Map 83 S.E.)

1. Boring near railway-bridge on the Wainfleet branch line.

Information from Mr. Wield, of Great Northern Railway, Louth.

		Ft.
Glacial Drift	Reddish marly clay - - - - -	9
	Sand and gravel - - - - -	2
	Soft clay, with a few stones - - - -	7
	Sand and gravel, with water - - -	6
		24

2. Well noted by J. A. Clarke.

		Ft.
Glacial Drift.	Clay - - - - -	12 or 15
	Gravel - - - - -	—

Folkingham.

(1 in. Map 70, N.S., 143; 6 in. Map 124 N.E.)

Four-inch boring to depth of 300 feet, variable supply. "Particulars doubtful, but one stratum of rock was passed through, about 100 feet in thickness." [=Lincolnshire Limestone.] J. Addy, *Proc. Inst. C. E.*, lxxiv. (1883), 161.

* Dr. R. B. Low, Report to Local Government Board, 1893.

Fosdyke.

(1 in. Map 69, N.S., 144; 6 in. Map 127 N.W.)
Coastguard Station, 1875.
Made and communicated by Messrs. S. F. Baker & Sons.
Unsuccessful.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Depth of well (the rest bored), partly in sand and gravel		—	21 0
Sand and gravel		57 0	78 0
[Glacial Drift]	Yellow sandy clay [?Boulder Clay]	37 0	115 0
	[Boulder] Clay, light blue, with chalk-stones	51 6	166 6
[Kimeridge Clay]	Dark clay, with septarian bands	159 6	326 0

Fulstow.

(1 in. Map 85, N.S., 90; 6 in. Map 40 N.W.)
Communicated by Mr. W. Sargent.

	Ft.
Boulder Clay	60
Chalk	—

Gainsborough.

(1 in. Map 83, N.S., 101; 6 in. Map 42 S.E.)

1. Made by Messrs. E. Timmins & Sons, at southern end of town, near the river Trent. Date 1885–1887. Communicated in part by Mr. A. Timmins; *see* also C. E. De Rance, *Proc. Yorksh. Geol. Soc.*, xii. 25; and F. M. Burton, in "Victoria History" of Lincolnshire, article "Geology." Sunk 58 feet, the rest bored. Water level about 6 feet from surface when bore was first made. Yield up to 25,000 gallons per hour. Contains 32·20 grains of mineral matter per gallon.

		Thickness.	Depth.
		Ft. in.	Ft. in.
[Keuper Marl]	Soil (not noted.)		
	Red marls with much gypsum to 350 feet, and very little below	720 0	720 0
[Keuper and Bunter Sandstones]	Fine sandstones (partly micaceous) with bands of red marl and a few small pebbles	320 0	
	Coarse hard sandstone and pebbles	300 0	
	Finer red sandstone, with pebbles	175 1	1,515 1

The water, as stated by Mr. De Rance, is mixed in the well with some upper waters, to which its hardness is due. Its hardness on Clarke's scale is 25·76, of which 16·31 is permanent, and 9·45 temporary. There is every reason to believe that, if the whole of the water were derived from the Red Sandstone it would be found much softer.

The supply, as noted by Dr. L. W. D. Mair (Report to Local Government Board, No. 139, 1899), has been regularly supplied to the town since 1889, but "has at no time been sufficient to meet all requirements," and "it has been necessary almost always to supplement the supply daily by water derived from the river."

When pumping from a depth of 200 feet the water falls to 100 feet from surface.—Rest-level in bore hole 15·29 feet above O.D.

2. A second boring adjacent to the first, made (1894–1900) under direction of Mr. P. Griffith, by Messrs. E. Timmins & Sons, has been carried to the base of the [New Red] Sandstone beds, which were met with at a depth of nearly 1,500 feet from the surface. An abundant and excellent supply of water has been obtained. (*Water*, ii. (1900) 282.)

The following particulars were supplied by Mr. Percy Griffith to Mr. H. Preston:—

	Ft.
Surface deposits	8
Marl with gypsum	718
Sandstone (with marl bands to 987 feet)	789
	1,515

The rest-level in this Borehole, No. 2, when the pumping of about 22,000 gallons per hour takes place from Borehole No. 1 (96 feet distant), is 88 feet below the surface. The maximum yield from No. 2 Borehole (pump at 300 feet from surface) is about 30,000 gallons per hour.

3. Two boreholes made in 1881, on the east side of the Trent, 20 chains south of Gainsborough Bridge, in Ashcroft Field, near the Great Northern Railway Company's siding, were noted by Mr. W. A. E. Ussher:—

	No. 1.	Ft.	No. 2.	Ft.
Alluvial Deposits.	Soil	6	Soil and warp	9
	Warp	3	Peat and bog	21
	Peat	7	Sand	—
	Bog	9		
	Gravel	5		
		30		30

For Analyses, see p. 203.

Garthorpe.

See p. 203.

Gayton-le-Marsh.

(1 in. Map 84, N.S., 104; 6 in. Map 57 N.W.)

1. Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker.)

		Ft.
Surface soil		1½
Glacial Drift	Marly clay, yellow near the surface, harder below, and getting darker towards the bottom, with chalk stones and other pebbles	66
	Clean sand	7½
	Sand, with small chalk stones	3
		78

2. A farm (? Slates Farm) in the marsh, two miles N.E. of the Church. From information obtained on the spot.

			Ft.
Alluvium	Warp clay	about	30
	Silt	„	10
Boulder Clay	Marl, with whites	„	40
	"Croy," and Chalk	„	10
			90

Gonerby, Little.

Well, near Railway.
(1 in. Map 70 N.S., 127; 6 in. Map 113 S.E.)
Made by Mr. F. Hobson, 1900. Communicated by Mr. H. Preston.
No Water.

Well is 30 ft. deep. All hard blue clay, containing *Ammonites capricornus*, and fragments of oysters: Lower Lias.

Goxhill.

(1 in. Map 86 N.S., 80; 6 in. Map 7 N.E.)
Communicated by Mr. Westaby.

1. S. part of Goxhill Marshes.

		Ft.
Warp	about	5
Chalk		—

2. S. part of Goxhill Marshes.

		Ft.
Warp	about	60
Chalk		—

3. Half-mile N.E. of Ox Marsh Farm.

		Ft.
Warp	about	50
Chalk		—

4. At Ox Marsh Farm.

		Ft.
Warp		?
Strong red clay with chalk		27
Chalk		—

5. Near the Station.

		Ft.
Clay		48
Chalk		—

6. The Priory, South End.

		Ft.
Hard clay with stones		45
Chalk		—

7. Littleworth.

		Ft.
Clay		39

Grainsby.

(1 in. Map 85, N.S., 90 ; 6 in. Map 39 N.E.)
Grainsby Hall.
Communicated by Mr. Joseph Jackling.

		Ft.
Strong clay	about	84
Chalk		—

Grantham.

(1 in Map 70, N.S., 127 ; 6 in. Map 113 S.E.)
1. Well at Union Workhouse.
Made by Frank Hobson, well-sinker.
Communicated by Mr. H. Preston.
6 feet of water ; yield, sufficient for present requirements.

		Thickness.	Depth.
		Ft. In.	Ft. In.
Middle Lias : beds immediately below the Marlstone Rock	Soil and subsoil	2 0	—
	Sandy shale	5 0	7 0
	Clay and dice	6 0	13 0
	Soft sandstone rock	2 0	15 0
	Clay (marl) and stone	5 0	20 0
	Red rock (ironstone)	1 0	21 0
	Red clay and stony shale	3 0	24 0
	Red rock (ironstone) with signs of water	2 0	26 0
	Blue bind	3 0	29 0
	Rotten brown rock	6	29 6
	Red (irony) shale	2 6	32 0
	Grey rock. This gave the main supply of water	10	32 10
	Blue bind	8 0	40 10
	Blue lias (clay) loose and very open	4 0	44 10
	Blue rock. Water lost in this rock	10	45 8
	Loose blue marl with ironstone concretions	14 0	59 8

This well is about 150 yards to the west of the section given on bottom of page 35, *Geology of the South-west part of Lincolnshire* (sheet 70, old series).

2. Union Street, near the Roman Catholic Chapel.
Communicated by Mr. Marsh.

		Ft.
[Valley Drift]	Gravel	5
[Middle Lias]	Blue clay	6
	Thin layers of boulders (? septaria)	½ to 1
	Stiff blue clay	75
		87

3. At Mr. Pawson's, No. 87, Westgate.

Communicated by Mr. W. Burrows of Great Gonerby.

Water rose 15 feet.

		Ft.
[Valley Drift]	Sand	24
	Gravel	2
[Middle Lias]	Clay	6
		32

4. Boring at Messrs. R. Hornsby & Sons' Ironworks, Spittlegate.

Commenced 12 feet below road and 18 feet below the base of the Marlstone. 1874–1876.

Account obtained and specimens examined by W. H. Holloway.

			Thickness.	Depth.
			Ft. in.	Ft. in.
Valley Drift		Gravel	28 0	28 0
Middle and Lower Lias		Blue clays with septaria [zones of *Ammonites margaritatus* and *A. capricornus*]	162 0	190 0
Lower Lias	Zone of *Ammonites Jamesoni*	Sandy ferruginous limestone, micaceous and fossiliferous	0 6	—
		Dark blue clay	16 6	—
		Very ferruginous sandy limestone	0 5	—
		Light blue clay	46 7	—
		Light brown septaria	0 8	—
		Blue clays, micaceous and laminated in places	166 4	—
		Stone	0 10	—
		Dark blue and grey clay with septaria	70 2	492 0
	Zone of *Amm. armatus*, 25 feet.	Lighter-coloured micaceous sandy clay	21 0	—
		Brownish ferruginous and blue sandy clay with calcareous particles apparently in thin alternations	4 0	517 0
	Zone of *Amm. oxynotus*. 85 feet.	Light blue clay	14 0	—
		Hard grey septaria	1 0	—
		Blue clay	66 0	—
		Stone	0 6	—
		Dark blue clay slightly sandy	3 6	602 0
	Zone of *Amm. semicostatus*	Clay with bands of stone	11 0	613 0

4. Boring at Messrs. R. Hornsby & Sons' Ironworks—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Lower Lias — Zones of *Amm. angulatus* and *A. Bucklandi*, 173½ feet	Clay with bands of stone	173 6	786 6
Lower Lias — Zone of *Amm. planorbis* 43½ feet	Clay with bands of stone	7 1	793 7
	Tough dark bluish and greenish sandy clay	4 5	798 0
	Clay with bands of stone	32 0	830 0
Rhætic Beds 23·½ feet	Stone	0 5	830 5
	Blue clay	1 7	832 0
	Light grey micaceous and sandy clay	20 0	852 0
	Very hard stone	1 4	853 4
Keuper	Hard red clay	—	—

5. Harrowby Hill, East of Grantham.

Rev. P. B. Brodie, *Ann. Nat. Hist.*, ser. 2, vol. vi., p. 262 (1850).

(6 in. Map 114, S.W.)

	Ft.	in.
Soil	0	6
Rubble	6	0
Inferior Oolite [?Limestone, Clay and Sand]	40	6
Lias	10	0

6. Borings for the New Grantham Brick Co.

(1 in. Map 143; 6 in. Map 113 S.E.)

Made by Mr. J. E. Noble.

Communicated by Mr. H. Preston.

No Water.

Two Borings made in field off Papermill Lane, south of present Brickyard :—

No. 1 - - 36 feet deep.
No. 2 - - 28 feet deep.

All in blue clay (Upper Lias.)

Grayingham.

(1 in. Map 86, N.S. 89; 6 in. Map 36 S.W.)

Well at Warren farmyard.

Communicated by Mr. Nicholson to Mr. Ussher.

		Ft.
Lincolnshire Limestone	Limestone	2
	Sandy shale (? Kirton Beds.)	24

Grebby.

(1 in. Map 84, N.S., 116; 6 in. Map 75 S.W.)

At cottages by Grebby Mill, half a mile N.W. of Scremby.

		Ft.
Carstone	Brown sand	34
Tealby Beds	Bluish clay	3
		37

Greetwell.

(1 in. Map 83, N.S., 114; 6 in. Map 70 N.E.)

On the hill north of the railway-cutting.

		Ft.
Lincolnshire Limestone.	Oolitic limestone	65

Grimoldby.

(1 in. Map 84, N.S., 103; 6 in. Map 48 S.E.).

Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker).

1. At. Pickhill Farm, bored in 1862.

		Ft.
Glacial Drift	Yellow clay	6
	Marly clay	30
	Grey sand	16
	Dark clay, with small chalk stones and pebbles	27
	Sand	8
Loose Chalk		3
		90

2. At a house near the Plough Inn.

		Ft.
Glacial Drift	Dug in Marl	10
	Bored through Marl	60
Chalk Rubble		9
		79

3. At a farm on the border of the Marshland one mile N.E. of Grimoldby Church.

Water overflowed to height of 7 feet.

	Ft.
Depth to Chalk	72

4. At the Schools.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

		Ft.
Glacial Drift	Dug in clay	11
	Bored in clay Sand and rubble	75
Chalk rock		9
		95

Grimsby.

(1 in. Map 86, N.S., 90; 6 in. Map 22 N.E.).

1. Borings for the Water-works.

Bored, and communicated by Messrs. Mather & Platt (to Mr. C. E. de Rance).

First bore-hole south-west of Grimsby, near Little Coates.

	Ft.
Very soft clay, full of vegetable matter	21
Gravel and sand	3½
Clay	5
Rough gravel and small flints	2
Fine soft clay and small flints	2
Rough gravel	11½
Fine gravel	15
Chalk, very hard	15
	75

Water rose from the Chalk 4 feet above ground in great quantity. At 24 feet from the surface there is only a yield of from 7,500 to 8,000 gallons per hour.

Second bore-hole east of Grimsby (Cleethorpes). See also p. 82.

(1 in. Map 85).

	Ft.
Stiff bluish-brown clay with flakes of Chalk and a few fossils	84
Sand and gravel	15
Chalk with flints, in beds	125
	224

The top of the Chalk is very rotten and seems to be all broken up; it had to be tubed to 120 feet from the surface. Mr. De Rance states that "The yield from this boring is only about 180,000 to 192,000 gallons per day," and when this quantity is pumped, the neighbouring wells lose their supply of water.—*Rep. Brit. Assoc.* for 1895,

2. On the Marshes.

Communicated by Mr. W. Sargent.

	Ft.
Wood at 27 feet; To rock [Chalk]	78

3. On the Humber shore near the new timber ponds.

Communicated by Mr. Maughan.

No. 1.

		Ft.
Alluvium	Blue clay	18
	Black peat	1½
	Sand and gravel	1½
	Marsh clay (brown)	8
		29

No. 2.

		Ft.
Alluvium	Blue clay	24
	Peat	seam
	Silt and water	3
	Blue clay	—
		27

No. 3.

		Ft.
Alluvium	Good blue clay	30
	Peat	1
	Brown clay	—
		31

4. Grimsby Docks. Well carried into the Chalk, 300 feet deep; the water is clear and palatable. (De Rance, *Rep. Brit. Assoc.* for 1885.) See Analyses, p. 204.

Gunby.

(1 in. Map 84, N.S., 116; 6 in. Map, 83 N.E.).

1. At the cottage N.E. of the Church.

	Ft.
Brown clay, with sand at the bottom	25

2. At cottage half a mile south of Church.

	Ft.
Brown clay into sand	40

3. At the Hall.

	Ft.
Bored through clay into sand	70

Probably through Tealby Clay into the Spilsby Sandstone.

Gunhouse.

(1 in. Map, 86 N.S., 89; 6 in. Map 18 N.W.).

1. Well at the Inn at Gunhouse Wharf.

Communicated by Mr. Cressey, well-sinker, to Mr. W. A. E. Ussher.

		Ft.
Alluvium	Strong warp	10
	Clay	3
	Silty warp	14

2. Well on the south-east of Neap Ho.

Alluvium	Sand bed	11 feet.
	Peat, about 2 feet	
	Sand, 8 or 9 feet	

Hacconby.

Boring at Hacconby Fen.

(1 in. Map 70, N.S., 144; 6 in. Map 133 S.W.)

Made by Mr. Noble, Bourn. 1904.

Communicated by Mr. Henry Preston.

Water overflows; yield about 12,000 per hour from a 6-inch boring.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvium	Soil	1 0	1 0
	Clay	7 9	8 9
	Gravel	2 9	11 6
Oxford Clay	Clay	62 6	74 0
Kellaways Beds	Sandy rock	11 0	85 0
	Clay	9 8	94 8
Cornbrash	Soft rock	5 0	99 8
Great Oolite Clay	Clay	20 1	119 9
Great Oolite Limestone	Rock	10 5	130 2
Upper Estuarine Series	Clay	21 6	151 8
	Grey marl	17 0	168 8
Lincolnshire Limestone	Rock	6 0	174 8

Hagworthingham.

(1 in. Map 84, N.S., 115; 6 in. Map 74 S.W.).

Information from Mr. Brooks (well-sinker).

1. At. Mr. Swaby's house, a quarter of a mile N.W. of the church.

	Ft.
[Boulder Clay] Yellow clay	4
[Spilsby Sandstone] Sand, with hard rock at bottom	50
	54

2. At a farm called Westerby, one mile W. of Hagg.

	Ft.
[Boulder Clay] White clay	20
Spilsby Sandstone { Sand rock	4
Spilsby Sandstone { Sand	30
	54

Hainton.

(1 in. Map 83, N.S., 103; 6 in. Map 54 N.E.).

Communicated by Mr. James Freeborough (well-sinker).

Hainton Hall Stables.

	Ft.
White marl	30
Blue clay with chalk and flints	15
Blue shale [Kimeridge clay].	
	45

Hainton Walk Farm, one mile south-east of Sixhills.

	Ft.
Yellow fine clay	15
Blue stone [Tealby Limestone]	12
Blue and white clay [Tealby Clay]	33
	60

A boring was put down to a further depth of sixty feet, passing through soft blue clay and reaching soft sand, presumably the top of the Spilsby Sandstone.

Hale, Great.

(1 in. Map 70, N.S., 128; 6 in. Map 107 S.W.).

1. Town Well.

Communicated by Mr. J. Cocks.

Sunk 21 feet. Bored 210 feet. All clay and dice [Boulder Clay and Oxford Clay.]

2. Boring made in 1898.

Communicated by Mr. Jesse Clare.

Height, 27 feet above O.D.

Water came up at 310 feet 3 inches at rate of 5,500 gallons in twenty-four hours, and on completion at rate of 37,000 gallons in twenty-four hours, with 11 lbs. of pressure 2 feet above surface.

On analysis the water was said to be excellent for a village-supply.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Surface soil and clay (blue)		99	0	99	0
Glacial Drift and Oxford Clay	Stone [? Septarium]	1	0	100	0
	Blue clay	94	0	194	0
	Stone	1	6	195	6
	Clay	25	0	220	6

2. Boring made in 1898—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Cornbrash	Stone	7 0	227 6
Great Oolite Clay	Clay	22 6	250 0
Great Oolite Limestone	Stone	9 0	259 0
Upper Estuarine Series	Clay	10 0	269 0
	Stone	1 6	270 6
	Clay	20 6	291 0
Lincolnshire Limestone	Stone (hard)	12 0	303 0
	Stone (very hard)	3 3	306 3
	Stone and clay in beds	3 6	309 9
	Stone varying in hardness	19 3	328 0

Halton, East.

(1 in. Map 86, N.S. 81; 6 in. Map 8 N.W.)

1. Halton Skitter Kilns.

Communicated by Mr. Westaby.

	Ft.
Warp - - - - - - - - about	60
Chalk - - - - - - - - - -	—

2. Tile-kiln 1 mile S.E. of Halton Skitter.

Communicated by Mr. Westaby.

	Ft.
Warp - - - - - - - - - about	55
Chalk - - - - - - - - - -	—

3. Boring ½ mile N.W. of Halton Skitter Haven.

Communicated by Mr. Fisher.

	Ft.
Brick clay - - - - - - - - - -	6
Soft blue clay and silt - - - - - - - -	24
Hard marl clay [Boulder Clay] - - - - - -	10
Soft Chalk - - - - - - - - - -	5
	—
Hard Chalk at - - - - - - - - - -	45

Hannah.

(1 in. Map 84, N.S., 104; 6 in. Map 66 N.E.)

Near the Church.

Communicated by Mr. J. Bingley, of Aby (well-sinker.)

	Ft.
Clay [Boulder Clay] - - - - - - about	70
Sand - - - - - - - - „	6
Chalk rock - - - - - - - - „	21
	—
	97

Harlaxton.

(1 in. Map 70, N.S., 143; 6 in. Map 122 N.E.)

Made by Mr. H. Hobson, (well-sinker), for the Warren Farm. Communicated by Mr. H. Preston.

1. Well sunk 30 feet deep through Upper Lias clay. At the bottom of well the clay was shaly with bands of fine sand between the shaly layers. Water came in here, but was found to be polluted by the stables.

2. The well which now supplies the farm is about a quarter of a mile east of the premises, 33 feet deep through Upper Lias. Water stands 10 feet in the well, but the supply is very small.

Haxey.

(1 in. Map 86, N.S. 88; 6 in. Map 25 S.W.)

Boring at South Carr, three miles S.W. of Haxey, near Idlestop.

Communicated by Mr. Lionel B. Wells, M.Inst.C.E.

Completed July, 1893. by Messrs. Vivian. (*Trans. Manchester, Geol. Soc.*, xxvii. 58, 1901.)

			Thickness.			Depth from Surface.		
			Yds.	ft.	in.	Yds.	ft.	in.
	Alluvial 32 feet.	Soil	0	1	6			
		Sand	2	2	0			
		Sand and clay	2	0	6			
		Sandy clay	1	0	6			
		Sand	3	0	0			
		Sandy clay	0	0	6			
		Sand and gravel	1	0	0	10	2	0
Trias. Upper, 105 ft. 7 in.	Keuper.	Red and blue marl	1	0	0			
		Red and blue marl, with gypsum	3	1	6			
		Grey sandstone	0	1	0			
		Grey limestone	0	1	6			
		Red and blue sandy marl, with gypsum	13	1	7			
		Red and blue marl, with gypsum	1	1	0			
		Blue marl with gypsum	5	0	0			
		Red and blue marl, with gypsum and sandstone	8	0	0			
		Red marl	2	0	0	45	2	7
Lower, 608 ft. 7 in.		Red and grey sandstone	35	0	8			
		Red and grey sandstone, with marl	10	0	11			
		Red and grey sandstone	52	2	1			
		Red and grey sandstone, with blue shale	11	1	0			
		Red and grey sandstone	5	0	0			
		Red and grey sandstone, with shale and marl	32	2	4			
		Red and grey sandstone	4	1	0			
		Red and grey sandstone, with shale and marl	26	0	1			

Boring at South Carr—*continued.*

			Thickness.			Depth from Surface.		
			Yds.	ft.	in.	Yds.	ft.	in.
Trias.	Bunter, 437 ft. 4 in.	Red sandstone	25	0	6	248	2	2
		Red sandstone, with pebbles	68	2	10			
		Red sandstone, with pebbles and marl	3	1	0			
		Red sandstone, with pebbles	18	1	1			
		Red sandstone, with marl	3	2	6	343	0	7
		Red sandstone	11	2	5			
		Red sandstone, with marl	38	1	6			
		Red and grey sandy marl, with gypsum	1	0	0	394	1	6
Permian, 544 ft. 9 in.	Upper Marls.	Red marl, with gypsum	1	1	0			
		Anhydrous gypsum	2	2	10			
		Hard red sandy marl, with gypsum	0	2	8			
		Hard red and grey marly sandstone, with gypsum	1	0	6			
		Red and grey sandy marl, with gypsum	1	1	3			
		Red marl, with gypsum	5	2	6			
		Red marl, with gypsum and limestone	3	0	0			
		Red and brown marl, with gypsum and limestone	1	2	4			
	Upper Magnesian Limestone.	Fine grey sandstone, with gypsum	10	0	10	423	0	5
		Grey limestone	17	2	0	440	2	5
	Middle Marls.	Blue marl, with gypsum	2	1	2			
		Red marl, with gypsum	14	2	8			
		Rotten red marl, with gypsum	4	2	0			
		Blue marl, with gypsum	1	0	0			
		Rotten red marl, with gypsum,	3	2	11			
		Brown and blue marl, with gypsum	17	1	0			
	Lower Magnesian Limestone.	Brown marl, with limestone	1	1	6	486	1	8
		Limestone, red and blue marl, with gypsum	3	2	6			
		Grey limestone	6	0	4			
		Grey limestone, with shale	9	1	7			
		Light grey limestone	3	0	0			
		Grey limestone, with shale	61	2	8			
		Grey shale	4	0	0			
		Mottled shale	1	0	0			
		Red shaly limestone	0	0	6	576	0	3
Coal Measures.	Rotherham Red Rock.	Mottled sandy shale	1	2	0			
		Mottled shale	1	1	0			
		Red and grey sandstone	2	1	0			
		Mottled shale	1	0	0			
		Red and grey sandstone	15	2	1			
		Coarse red sandstone	0	2	6			
		Grey sandstone	9	0	2			
		Blue shale and grey sandstone	2	2	0			
		Coal	0	1	3	611	0	3
		Fire-clay and ironstone nodules	1	1	6			

Boring at South Carr—*continued.*

	Thickness.			Depth from Surface.		
	Yds.	ft.	in.	Yds.	ft.	in.
Black shale	0	1	6			
Blue shale	5	0	6			
Grey sandstone and blue shale	0	1	6			
Coal and black shale	0	0	5	618	2	8
Dark blue shale and ironstone nodules	7	1	3			
Soft grey Coal. Coal 10 in. / Black shale 2 in.	0	1	0	626	1	11
Fire-clay	0	2	0			
Blue sandy fire-clay and ironstone nodules	5	2	0			
Blue sandy shale	4	1	0			
Grey sandstone	2	1	6			
Dark blue shale	0	2	6			
Shafton Coal: Fire-clay, 1 ft. 7 in. / Coal 3 ft. 1 in. / Fire-clay 1 ft. 8 in.	2	0	4	642	2	3
Grey sandstone and sandy shale	2	1	0			
Dark blue shale	2	0	10			
Dark blue shale and ironstone nodules	3	0	1			
Grey sandy shale	7	1	8			
Grey sandstone	0	1	9			
Coal	0	0	8	658	2	3
Fire-clay and ironstone nodules	4	1	5			
Dark blue shale	2	0	0			
Grey sandstone	0	0	7			
Dark blue shale	5	1	0			
Fireclay and ironstone nodules	2	1	7			
Blue shale and ironstone nodules	6	0	3			
Blue sandy shale	9	0	0			
Grey sandstone	11	0	0			
Dark sandy shale	0	1	0			
Grey sandstone	4	0	6			
Grey sandstone and shale	2	2	0			
Dark shale and ironstone nodules	2	1	6			
Fireclay and ironstone nodules	11	1	5			
Blue shale	1	1	5			
Fireclay and ironstone nodules	3	0	7			
Fireclay	7	1	0			
Bagshaw coal: Black shale 0 ft. 6 in. / Coal 1 ft. 7 in.	0	2	1	733	0	7
Fireclay	3	0	6			
Grey sandstone (Oaks Rock)	13	0	9			
Blue sandy shale (Oaks Rock)	0	1	6			
Grey sandstone (Oaks Rock)	17	1	4			
Blue sandy shale	5	1	10			
Dark sandy shale	1	1	0			
Fireclay	1	0	0			

Coal Measures, 1,457 ft. 7 in.

Boring at South Carr—*continued.*

	Thickness.			Depth from Surface.		
	Yds.	ft.	in.	Yds.	ft.	in.
Grey sandy shale and sandstone bands	2	2	0			
Fireclay	2	0	0			
Grey sandstone	1	2	7			
Dark shale and ironstone	2	1	0			
Black shale	0	1	6			
Grey sandy shale	3	1	2			
Grey sandstone	2	1	10			
Fire-clay	6	2	0			
Black and grey shale	0	0	10			
Swinton Pottery Coal: Coal 2 ft. 9 in.; Fire-clay 3 in.; Coal 9 in.	1	0	9	799	0	2
Fire-clay	0	1	4			
Grey sandstone	23	1	9			
Black shale	0	1	8			
Coal	0	1	3	824	0	2
Fire-clay	3	2	7			
Light grey shaly sandstone	2	1	0			
Dark grey shaly sandstone	2	2	0			
Fireclay and ironstone nodules	1	1	9			
Black shale and ironstone	10	0	5			
Fireclay	0	2	0			
Grey sandstone	3	2	7			
Blue sandy shale	0	2	0			
Dark sandy shale	6	2	8			
Blue sandy shale and sandstone bands (Wooley Edge Rock.)	6	0	0			
Black shale	1	0	6			
Coal: Blue shale and ironstone nodules 2 ft.; Coal 10 in.	0	2	10	864	2	6
Fire-clay	1	0	2			
Blue sandy shale and ironstone nodules	2	1	6			
Black shale and ironstone nodules	5	0	0			
Wathwood coal	0	0	11	873	2	1
Fire-clay	0	1	0			
Grey sandstone	2	0	9			
Dark sandy shale	1	1	8			
Dark sandy shale and ironstone nodules	1	0	3			
Shaly sandstone	0	2	6			
Sandy shale	1	2	6			
Grey sandstone	0	2	6			
Blue shale and ironstone nodules	3	2	0			
Shaly sandstone	0	2	0			
Blue shale	0	1	0			
Blue shale and ironstone nodules	2	0	4			
Two-foot coal: Black shale 2 in.; Coal 10 in.; Fire-clay 1 ft. 0 in.	0	2	0	889	2	7

Coal Measures, 1,457 ft. 7 in.

Boring at South Carr—*continued.*

	Thickness.			Depth from Surface.		
	Yds.	ft.	in.	Yds.	ft.	in.
Blue shale and ironstone nodules	7	1	0			
Light blue shale and ironstone nodules	2	1	6			
Blue shale and ironstone nodules	1	2	0			
Dark blue shale and ironstone nodules	1	1	3			
Abdy or Winter Coal. Black shale 8 in. / Coal 1 ft. 0 in.	0	1	8	903	1	0
Light blue shale and ironstone nodules	6	1	4			
Grey sandstone	22	1	2			
Blue shale	0	1	0			
Black shale and coal	0	1	6	933	0	0
Blue sandy shale	2	1	6			
Grey shaly sandstone	2	0	11			
Grey shaly sandstone and ironstone nodules	5	1	0			
Blue shale and ironstone bands	5	0	6			
Blue sandy shale	0	2	10			
Low Beamshaw Coal. Fire-clay 3 in. / Coal 1 ft. 0 in. / Black shale 2 in.	0	1	5	949	2	2
Grey sandstone	1	2	0			
Blue shaly sandstone	1	1	8			
Blue shale and hard sandstone bands	9	1	9			
Black shale (Kent's thin coal)	0	1	0	962	2	7
Blue sandy shale and ironstone bands	8	0	0			
Blue sandy shale and hard sandstone bands	6	0	6			
Grey sandstone (Kent's thick rock)	15	0	0			
Blue sandy shale and hard sandstone bands	7	2	6			
Grey shaly sandstone	1	0	9			
Black shale	1	1	5			
Kent's Thick Coal. Coal 4 in. / Black shale and coal 3 in. / Fire-clay 1 ft. 2 in. / Coal 7 in. / Fire-clay 2 in. / Coal 1 ft. 11 in. / Fire-clay 1 ft. 0 in.	1	2	5	1004	1	2
Blue sandy shale	1	1	0			
Grey shaly sandstone	3	1	10			
Blue shale and ironstone bands	4	0	4			
Blue shale	1	0	8			
Blue sandy shale	2	0	0			
Grey sandstone	2	0	0			
Blue shale	2	1	0			
Blue shale and irony bands	4	2	0			
Blue sandy shale	0	1	6			
Grey sandstone	0	2	6			
Blue shale and irony bands	2	0	0			
Grey sandstone	6	1	8			
Blue sandy shale	0	1	9			
Blue shale and irony bands	4	0	0			

Coal Measures, 1,457 ft. 7 in.

Boring at South Carr—*continued.*

		Thickness.	Depth from Surface.
		Yds. ft. in	Yds. ft. in
Coal Measures, 1,457 ft. 7 in.	Black shale	1 0 6	
	Blue shale and irony bands	2 2 2	
	Black shale	0 1 0	
	Barnsley Coal. Coal: Coal 1 ft. 0 in.; Fire-clay 3 ft. 6 in.; Coal 4 ft. 1 in.; Coal and dirt 4 in.; Coal 4 in.	3 0 3	1047 1 4
	Soft fire-clay	0 2 0	
	Grey shaly sandstone & ironstone nodules	5 2 9	
	Blue shale and ironstone bands	5 2 10	
	Dark blue shale	0 0 8	
	Coal	1 1 7	1061 2 2
	Sandy fireclay	0 0 8	1061 2 10

See Analyses, p. 204.

Haydor.

(1 in. Map 70, N.S., 127; 6 in. Map 114 N.E.).

1. Weaver's (Haydor) Lodge, Haydor Lane.

Information from Mr. Burrows, Great Gonerby.

	Ft.
Lincolnshire Limestone rock	96
Upper Lias clay	8

2. Cottage half a mile E. of Nightingale Inn, about one mile E. of Ropsley Heath Farm.

Information obtained in 1874 by W. H. Holloway, who ascertained that well was dug about 1820, and was only once known to be dry, namely, in winter of 1873-74. In June 1874 there was about twenty feet of water.

	Ft.
Lincolnshire Limestone and underlying clay	135

Heckington.

(1 in. Map 70, N.S., 128; 6 in. Map 107 S.W.).

1. At Mr. Sharpe's.

Information from Mr. Joseph Cocks.

Sunk 15 feet, bored 167 feet. Clay with chalk-stones [Boulder Clay] in the upper part; and some chalk found within a few inches of the bottom. Water obtained from silt at the bottom and rose to within three or four feet of the surface.

2. Boring at the west end of the village, made in 1896.
Communicated by Mr. Jesse Clare, of Sleaford.
Water overflows at rate of about 6 gallons a minute. (See Analysis, p. 205.)

		Thickness.	Depth.
		Ft. in.	Ft. in.
Drift	Soil and gravel	10 0	10 0
Oxford Clay and Kellaways Beds	Clay	221 0	231 0
	Rock	4 0	235 0
	Clay	3 0	238 0
	Sandy rock	8 0	246 0
	Clay	9 0	255 0
Cornbrash	Rock	7 0	262 0
Great Oolite Clay 22 feet.	Clay	11 0	273 0
	Rock	1 0	274 0
	Clay	2 6	276 6
	Rock	4 6	281 0
	Clay	3 0	284 0
Great Oolite Limestone 17 feet	Rock	9 0	293 0
	Clay band	0 6	293 6
	Rock, very hard	1 6	295 0
	Rock, softer	6 0	301 0
Upper Estuarine Series, 22 feet	Clay and stones (or shells)	3 0	304 0
	Rock	3 0	307 0
	Clay	16 0	323 0
Lincolnshire Limestone	Rock	15 0	238 0
	Rock, hard white, with water	38 0	376 0
	Clay and shale	1 0	377 0
	Hard rock with a soft vein at 385 feet	23 0	400 0

Helpringham.

(1 in. Map 70 N.S., 128: 6 in. Map 116 N.W.)
Helpringham Fen, 1901.
Communicated by Messrs. Barnes & Sharpe, Sleaford.
Water rose above surface about 18 feet, delivering about 5,000 gallons per hour. Quality very good and soft.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Glacial Drift	Blue clay	30 0	30 0
Oxford Clay and Kellaways Beds	Hard silty clay	64 0	94 0
	Rock	11 0	105 0
	Clay	9 0	114 0
Cornbrash	Rock	8 0	122 0
Great Oolite Clay	Clay	20 0	142 0
Great Oolite Limestone	Rock	16 0	158 0
Upper Estuarine Series	Clay	6 0	164 0
	Rock	2 6	166 6
	Clay	18 0	184 6
Lincolnshire Limestone	Rock (yielding water)	6 0	190 6

Hogsthorpe.

(1 in. Map 84, N.S., 116; 6 in. Map 76 N.W.)

Communicated by Mr. T. Newton, of Anderby (well-sinker).

1. At. Mr. Payne's, Helsey.

	Ft.
Marl (dug and bored)	54
Sand	10
Chalk	10
	74

2. At the Windmill, half a mile east of church.

Information from the Miller.

Water rises to within eleven feet of surface.

Well dug twenty-two feet, the rest bored.

			Ft.	in.
Glacial Drift	Hessle Beds 14 feet	Loamy marl	8	0
		Sand, with water	2	0
		Red marl	3	9
		Thin seam of gravel	0	3
	Purple Clay, 68 feet	Bluish marl	64	0
		Sand and rubble	4	0
		Chalk rock	2	0
			84	0

In the village the wells are only from twelve to fourteen feet deep, water being found in the upper bed of sand, in the Hessle clay. At the brickyard north of Hogsthorpe, Mr. Spalding stated that his well was dug and bored about eighty feet through clay into the Chalk.

Holbeach.

(1 in. Map 69, N.S., 144; 6 in. Map 135 S.W.)

1. The Eight-sailed Mill.

Information obtained by Mr. Skertchly.

		Ft.
Fen Beds	Soil	3
	Silt	2
	Sand	6
	Clay with shells, full of salt-water	19
		30

The town has been supplied partly from shallow wells sunk into the warp (Fen Beds) to a depth of about twelve feet, and partly from rain-water.

Horbling.

(1 in. Map 70, N.S., 127; 6 in. Map 124 N.E.)

1. J. Addy, *Proc. Inst. Civ. Eng.*, vol. lxxiv., p. 161.

		Ft.
	Soil	4
[Drift]	Gravel	5
[Cornbrash]	Rock	6
[Great Oolite Clay]	Blue clay	22
[Great Oolite Limestone]	Blue rock	14
[Upper Estuarine Series]	Clay, blue, green, and black	34
[Lincolnshire Limestone]	Kale	2
		87

2. Well at Capt. Smith's, in the village.

Communicated by Mr. J. Wadsley, of Horbling.

		Ft.
	Gravel	12
[Cornbrash]	Kaly rock	4
[Great Oolite Series]	Clean blue clay [? with rock]	38
	Rock (kaly, with small spring)	2
[Upper Estuarine Series]	Blue and green clays	31
[Lincolnshire Limestone]	Rock with water rising to surface	1
		88

3. Fen Farm, 2½ miles E. of Horbling.

(1 in. Map, N.S., 128; 6 in. Map 125 N.W.)

Information given to Mr. Skertchly by Mr. W. W. Dean, jun.

		Ft.	in.
Alluvium	Peaty soil	1	6
	Sandy clay with pebbles	2	0
Boulder Clay ? Oxford Clay	Clay	57	0
Kellaways Beds	Rock bed, full of fossils	1	3
		61	9

Horncastle.

(1 in. Map 83, N.S., 115; 6 in. Map 73 S.E.).

Drinking water obtained partly from the rivers Bain and Waring, and partly from shallow wells. (Sixth Report, Rivers Pollution Commission, 1874, p. 356.)

Boring for water at the Great Northern Railway Station.
Communicated by Mr. W. H. Kirkby.

	Ft.
Grey and white chalky Boulder Clay	44
Kimeridge clay	91
	135

The boring was abandoned, as there was no prospect of obtaining water at a reasonable depth.

See Analyses, p. 205.

Horsington.

(1 in. Map 83, N.S., 115; 6 in. Map 72 S.E.)

Well at the Rectory.

Communicated by the Rector.

	Ft.
Sand and gravel	6
Stiff dark Boulder Clay Lighter marly Boulder Clay	15
	21

The water soaks in from the base of the gravel.

Hough-on-the-Hill.

(1 in. Map, 70, N.S., 127; 6 in. Map 104 N.E.)

Well at Brandon.

Communicated by Dr. Eaton to Mr. H. Preston.

Well sunk 40 feet, bored 40 feet: total 80 feet.

All in blue clay (Lower Lias). Touched rock at bottom, probably ironstone of zone of *Ammonites semicostatus*, and found some water, but it was heavily charged with salt.

Hougham, Long Bennington and Marston.

(1 in. Map 70, N.S., 127; 6 in. Maps 104, S.W. & S.E.)

"The wells are from 15 to 30 feet in depth, are drysteined with stone or brick, and are not protected by any impervious material, such as clay, placed externally. The water from these wells is partly derived from that percolating between the layers of limestone, which occur in the Lias clay in which the wells are sunk, but it is probable that the greater part of it is derived from the water of the overlying subsoil. This Lias clay contains a large amount of gypsum, consequently the water from many of the wells is very hard and has a nauseous taste. In *Long Bennington*, owing to the small number of the wells, and the hardness of the water furnished by many of them, or its nauseous taste, many families employ the water from the river Witham for drinking and cooking purposes. This river, before it reaches Long Bennington, receives the effluent water from the Grantham sewage farm and liquid refuse from the villages of Marston and Hougham."—(Report by Dr. S. W. Wheaton to the Local Government Board, 1898.)

Howell.

(1 in. Map 70, N.S. 128; 6 in. Map, 107 N.W.)

Communicated by Messrs. Barnes and Sharpe, Sleaford.

Water rose 20 ft. above surface. Quality good, but with a slight percentage of "salt."

		Thickness.		Depth.	
		Ft.	In.	Ft.	In.
Boulder Clay and Oxford Clay	Blue clay	238	0	238	0
Kellaways Beds	Fossil rock	15	0	253	0
	Blue clay	10	0	263	0
Cornbrash	Rock	6	0	269	0
Great Oolite Clay	Clay	22	0	291	0
Great Oolite Limestone	Rock	12	0	303	0
Upper Estuarine Series	Clay	6	6	309	6
	Rock	3	0	312	6
	Clay	17	0	329	6
Lincolnshire Limestone	Oolite	37	0	366	6

Humby.

(1 in. Map 70, N.S., 143 ; 6 in. Map 123 N.E.)
Mr. Chapman's farmhouse.
Information obtained from the workmen by Mr. W. H. Holloway.

		Ft.	in.
	Soil	1	0
	"Rammel" (Cornbrash)	4	0
Great Oolite Clay	Soft light blue clay	2	0
	Darker blue clay	3	0
	"Kale"	0	3
	Hard blue clay	5	0
	"Kaly" rock	0	3
	Very hard blue clay	10	0
	Grey clay	2	0
	Rock	0	6
	Hard blue clay	6	0
	White sandy rock, with water, not pierced	0	6
		34	6

Hundleby.

(1 in. Map 84, N.S., 115 ; 6 in. Map 82 N.E.)
At Mr. H. Walker's, 1884.
Communicated by Messrs. Le Grand and Sutcliff.

		Ft.	in
Spilsby Sandstone	Sand	38	0
Kimeridge Clay	Hard blue clay	7	0
	Hard stone	0	6
	Blue stone	1	6
	Light-coloured silt	1	0
		48	0

Huttoft.

(1 in. Map 84, N.S., 104 ; 6 in. Map, 67 S.W.)
Communicated by Mr. Thomas Newton, of Anderby (well-sinker).

1. At Mr. Lutey's farm. Sunk 12 ft. ; the rest bored.	Ft.	2. At Mr. F. Robinson's farm. Sunk 10 ft. ; the rest bored.	Ft
Marl	76	Marl	58
Sand	10	Sand	14
Chalk	12	Chalk	12
	88		84

3. At Mr. J. Bradley's farm.

	Ft.
Marl (bored from surface)	62
Sand and gravel	12
Croy and Chalk	14
	88

4. At Mr. Needham's farm, Huttoft Bank.

		Ft.
Post-glacial, 25 feet.	Sand and silt	10
	Soft clay	15
Glacial Beds, 50 feet.	Marl	42
	Sand and gravel	8
	Chalk	14
		89

5. At the Steam-mill.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

Dug 14 feet, bored the rest.

	Ft.
Clay [Boulder Clay]	65
Sand and gravel	6
Rock [Chalk]	12
	83

Immingham.

(1 in. Map 86, N.S., 81 ; 6 in. Map 13 S.E.)

1. In Village.

Communicated by Mr. J. Smith.

	Ft.
Boulder clay	42 to 45
Sand	4 to 8
Clay	about 1
Gravel and sand	4 to 10
To Chalk	70 to 80

2. Immingham Marsh.

Communicated by Mr. J. Smith.

	Ft.
Blue warp	30
Rotten wood	1 to 3
Warp clay (bluer)	30

Near the Humber the Warp is more sandy.

Ingham.

(1 in. Map 83, N.S., 102 ; 6 in. Map 52, N.W.)

Wells and Trial-holes in Lower Lias with some Drift.

Communicated by Mr. J. W. Radcliffe to Mr. W. H. Dalton.

1. The Green.

	Ft.	in.
Clay and soil	3	6
Clay with limestone	1	6
Ironstone clay	4	0

Dry laminated clay.

2. Back of houses, N. of the Green.

	ft.	in.
Soil	1	0
Dirty clay	2	0
Dark clay with limestones, a few sand-creeks, no water	7	0

3. Back of houses, opposite the road to Lincoln.

	Ft.	in.
Garden soil	1	0
Clayey soil	1	6
Dark clay with small limestone nodules, which fell to pieces on exposure	3	6
Ironstone clay	1	0

Laminated clay.

4. West of road to Lincoln.

	Ft.	in.
Garden soil	1	0
Dirty clay	1	6
Dark clay with limestone nodules	6	0
Laminated clay.		

5, 6. Western end of space west of Church.

	Ft.	in.
S. side of road.		
Made earth	1	0
Laminated clay	5	0
N. side of road.		
Fine earth	3	0
Red sand	2	0
Laminated clay.		

7. Public Well, N.W. of Church.

	Ft.	in.
Water level 6 feet from surface.		
Soil	1	0
Sand	1	8
Yellow clay	1	10
Laminated clay	7	6

8. Churchyard.

	Ft.	in.
Mould	1 ft. to 1	6
Sand, wet	1	6
Stiff yellow clay.		

Ingoldmells.

(1 in. Map, 84, N.S., 116; 6 in. Map 76 S.E.)

At the mill (Mr. Stone's).

Communicated by Mr. Th. Newton, of Anderby (well-sinker.)

	Ft.
Soft buttery clay	40
Marl (Boulder Clay)	16
Sand	10
Chalk	12
	78

Keadby.

(1 in. Map 86, N.S., 88; 6 in. Map 18 N.W.)

Water supply from shallow wells, from river and canal, and from rain-water.

Keal.

(1 in. Map 84, N.S., 115; 6 in. Map, 82 S.E.)

Wells at houses along main road N. and W. of East Keal Church.

Information from Mr. Chester (well-sinker.)

		Ft.
Spilsby Sandstone	Soft yellow and green sandstone	30 to 35
	Soft green sand, with water	3 to 4
Kimeridge Clay	Blue clay	—
		33 to 39

Keisby.

(1 in. Map 70, N.S. 143; 6 in. Map 132 N.W.)
Communicated by Mr. H. Preston.
Well 90 feet deep.
Water contains 16 grains of Sodium Chloride per gallon.

Kelsey, South.

(1 in. Map 86, N.S., 89; 6 in. Map 37 N.W.)
Well at the Bull Inn, near the Church.
Communicated by the landlord, Mr. Boorne, to Mr. A. J. Jukes-Browne.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil		2 0	2 0
[Boulder Clay]	White clay	16 0	18 0
	Fine yellow sand	6 0	24 0

Kelstern.

(1 in. Map 83, N.S., 103; 6 in. Map 47 S.W.)
Communicated to Mr. Jukes-Browne by Mr. Charles Wilkinson, well-sinker, Louth.

1. Calcethorpe.

		Ft.
[Glacial Drift, Chalk, &c.]	White and black clay, "grey stone," and red sand	66

2. Lambcroft.

Dug and bored through 240 ft. of white chalk and "greystone" (hard grey Chalk).

Killingholme.

(1 in. Map 86, N.S., 81; 6 in. Map 13 N.W.)

1. About ¾ mile N.W. of South Killingholme Haven.
Communicated by Mr. Westaby.

	Ft.
Warp and silt sand	50
Chalk.	

2. Tile Kiln S. of Killingholme Haven.
Communicated by Mr. Westaby.

	Ft.
Warp, about	50
Chalk.	

3. Near the School House.
Communicated by Mr. John Smith, Immingham.

	Ft.
Well sunk in clay	24
Bored	60
To Chalk	84

4. Coast Guard Station. Communicated by Mr. Smith.

	Ft.
Warp, the lower part alternating chalk and clay [part probably Boulder clay], rock not touched	107

150 yards inland water was obtained at 54 or 56 ft. in shingly gravel.

5. Boring ¼ mile S. of S. Killingholme Haven. 1874. Communicated by Mr. Fisher.

		Ft.
Alluvium	Brick clay	6
	Soft blue clay	12
	Blue silt	8
	Wood and clay	2
	Strong blue clay	14
	Silt and loose sand	4
	Good brown clay	9
	Loose sand and gravel	7
	Brown clay	1
	Small gravel	1
	Blue clay and sand, in thin beds	7½
	Hard marly clay	2½
		74

6. Boring. ½ mile S.E. of North Killingholme Haven. Chalk at 55ft.

Kirkby, East.

(1 in. Map 84, N.S, 115; 6 in. Map 82 S.W.)

At house near corner of roads. Information from Mr. Orry, of Kirkby

	Ft.
Through gravel and silt to blue clay [Kimeridge Clay]	30

Kirton Lindsey.

(1 in. Map 86, N.S. 89; 6 in. Map 36 N.W.)

Communicated by Messrs. Daglish and Howse, *Trans. N. England Inst. Eng.*, xxiv., 25.

		Ft.
	Boulder clay, about	5
	Boulder clay, about	5
Middle Lias	Pecten bed ironstone, about	5
Lower Lias	Clay	140
	Frodingham ironstone.	

Kyme, South.

(1 in. Map 70, N.S., 128; 6 in. Map 98 S.E.)

Dug well to 40 feet; the rest bored. Communicated by Mr. H. Preston.

No supply of water.

		Ft.
	Soil	2
Alluvium	Blue dice	5
	Sand and gravel	3
Boulder Clay	Tough blue clay with chalk fragments	15
	Tough blue clay with large flints	15
Oxford Clay	Blue clay	20
		60

Langtoft.

(1 in. Map 64, N.S., 158; 6 in. Map, 147 N.W.)

Two-inch boring at Twopenny Cut Farm, Langtoft Fen, five miles east of village. Made by Mr. J. E. Noble., 1898.

Communicated by Mr. H. Preston.

Height above O.D., 10 ft. ; water overflows; yield 1,250 gallons per hour.

———		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Soil and Drift	Soil and subsoil	4	0	—	
	Clay	1	0	5	0
	Gravel	10	0	15	0
Oxford and Kellaways Series 100 ft. 11 in.	Clay	82	6	97	6
	Sandstone	10	3	107	9
	Clay	8	2	115	11
Cornbrash—8 ft. 8 in.	Rock	8	8	124	7
Great Oolite Clay 20 ft. 3 in.	Clay	16	0	140	7
	Rock	0	6	141	1
	Clay	3	9	144	10
Great Oolite Limestone 8 ft. 2 in.	Rock	8	2	153	0
Upper Estuarine Series 28 ft. 8 in.	Sandstone	3	0	156	0
	Rock	2	2	158	2
	Clay	19	6	177	8
	Rock	1	0	178	8
	Clay	3	0	181	8
Lincolnshire Limestone	Rock	62	5	244	1

Langton.

(1 in. Map 83, N.S., 115; 6 in. Map 73 S.W.)

1. Well at village.

Noted by Mr. A. C. G. Cameron in 1893.

	Ft.
Carstone	18
Tealby clay (with fullers earth at top)	

2. Langton Grange.

Information from Mr. Mackinder (tenant).

	Ft.
White chalk	about 100
Red chalk	„ 13
Carstone—Brown sand	„ 16
	129

Langworth.—*See* Sudbrooke.

Leake.

(1 in. Map 69, N.S., 128; 6 in. Map 100 N.E.)

1. Old Leake, five furlongs N.E. of the railway station, a boring made by Mr. Welsh of Boston in 1867 at a point on the East Lincolnshire Railway, seven miles southward from the Steeping River.

Communicated by Searles V. Wood (jun.).

		Ft.	in.
Fen Beds	Brown clay	4	0
	Peat	0	3
	Soft blue clay	3	6
	Peat	–	3
Hessle Beds	Strong marly clay	8	0
	Coarse yellow sand with water	4	0
Kimeridge Clay	Hard blue clay	9	0
		29	0

The strong marly clay said to contain "occasional bits of water-worn gravel and clear coarse yellow sand."

(1 in. Map, N.S., 115; 6 in. Map, 91 S.W.)

2. Lade Bank Engines, East Fen, north of Leake.

From Mr. W. H. Wheeler.

(*see* Skertchly, "Geology of the Fenland," p. 280) ? a well or a boring.

		Ft.	in.
Fen Beds	Clay	4	0
	Peat	0	6
	Soft blue clay	3	0
	Peat with pieces of trees	?	6
Boulder Clay	Hard clay with chalk-stones	22	0
		30	0

Laughton.

(1 in. Map 86, N.S. 89; 6 in. Map 35 N.W.)

Well at farm buildings near Laughton Wood.

Boulder Clay Lower Lias		20 feet.

Leasingham.

(1 in. Map 70, N.S., 127; 6 in. Map, 97 S.W.)

1. Two wells—one at Mr. Cooper's, and the other at Mr. H. Simmers', both alike.

Information from Mr. Joseph Cocks, well-sinker.

		Ft.
[Great Oolite Clay]	Dicey clay	16
[Great Oolite Limestone]	Rock with clay bands	21
[Upper Estuarine Series]	Dicey clay	66
[Lincolnshire Limestone]	Rock	2 or 3 in.
		103

The water rose to within 20 feet of the surface.

2. The easternmost house in the village (1885).

Sunk 32 feet. Bored 51 feet.

		Ft.
[Great Oolite Clay, &c.]	Well sunk through clay, &c.	32
[Great Oolite Limestone]	Rock	33
[Upper Estuarine Series]	Clay	18
[Lincolnshire Limestone]	Rock, touched.	
		83

The well-water at Leasingham has in some cases proved to be contaminated. (*See Water*, ii. (1900), 362.) See also Analyses, p. 206.

Leadenham.

(1 in. Map 70, N.S., 127; 6 in. Map 96 N.W.)

Boring made in 1904. Communicated by Mr. H. Preston.

Water-level, 13 feet below surface. Very small supply, intensely salt (see p. 206.)

		Ft.
Lower Lias	Soil and brown clay	2
	Blue clay	92½
	Hard blue stone	1½
		96

Lenton (Lavington).

(1 in. Map 70, N.S., 143; 6 in. Map 124 S.W.)

At Hanby, Sir C. Buck's, 7 miles E.S.E. of Grantham. Recorded by Sir H. C. Englefield, *Phil. Trans.*, lxxi. (1781).

Blue shaly clay with many casts of Tellina, a very little pyrites, and some few, small, but very elegant, Belemnites. Through the whole mass of clay were interspersed nodules of pure chalk of all sizes, from that of a pea to a child's head. [Boulder Clay.] No water found at 30 feet.

Limber, Great.

(1 in. Map 86, N.S., 90; 6 in. Map 21 S.W.)

1. At Mr. Frankish's. Communicated by Mr. John Smith.

	Ft.
Chalk with layers of flint	168

2. At Mr. Iles' Farm. Communicated by Mr. Westaby.

	Ft.
Clay with stones	12
Gravel	6
To Chalk	18

Lincoln.

(1 in. Map 83, N.S., 114; 6 in. Map 70 N.E.).

Supplied from impounding reservoirs, water "derived partly from springs and partly from a gathering ground of 2,000 acres, which is one-third of it cultivated and the remainder woodland." The Corporation have also power to take water from the Witham. (*Sixth Rep. Rivers Pollution Comm.* 1874, p. 367.)

It has been decided to bore at Boultham to obtain if possible a supply of water for Lincoln from the New Red Sandstone. See p. 63.

"There are no springs in the lower part of Lincoln; the water obtained there by the sinking of wells is the river water, which is filtered through the sand bed." (William Bedford, *Mag. Nat. Hist.* N.S., iii. 1839, 555.) Dr. Thresh (*Water and Water Supplies*, Ed. 3, 1901, p. 372) mentions an Abyssinian tube-well, sunk at Lincoln by Messrs. Le Grand and Sutcliff in 1894 to depth of 31 feet in sand: it yielded 200 gallons per hour, the water standing at 4ft. 6in. from bottom.

1. Crown Brewery Well, Waterside, South.

Communicated by Mr. Teague.

	Ft.
Made ground	7
Sand	14
Hard flinty gravel with water.	
	21

2. Well at No. 220, High Street.

Communicated by Mr. Teague.

	Ft.
Made ground	18
Old Roman Road (pavement, &c.)	2
Turf moor	15
Gravel with water.	
	35

3. At Mr. Dawber's Brewery, Carholme Road.

Communicated by Mr. Dawber.

	Ft.
Sand and gravel	40
Lias clay	140
	180

The well was sunk to the base of the sand and gravel, and the Lias was bored to the further depth of 140 feet. No water having been obtained from the Lias, the boring was abandoned. The present supply, which is plentiful, is derived from the sand and gravel, the well being supplemented by connected tube-wells.

4. The following series of borings along the Witham valley was made in 1879–80 for the Great Northern and Great Eastern Railways. They were communicated to Mr. Cameron by Mr. Samuel Abbott, C.E., of Lincoln.

The position of each boring is shown on the map Fig. 2.

Details are not given of Borings Nos. 1 to 4, as they were made through ground that was subsequently removed in the railway-cuttings.

See Geology of the Country around Lincoln, *Mem. Geol. Survey* (1888), pp. 39, 50, 63, 66, 165, 197.

No. 5 Boring, at 35 miles 75 chains from Spalding, Railway No. 1. Above Ordnance Datum 25·39 feet.

	Ft.	In.
Soil	4	0
Earth and small stones (not gravel); water	3	6
	7	6

FIG. 2.

Map showing the positions of Borings in the Alluvial deposits of the Rivers Witham and Till, near Lincoln.

Scale, one inch to a mile.

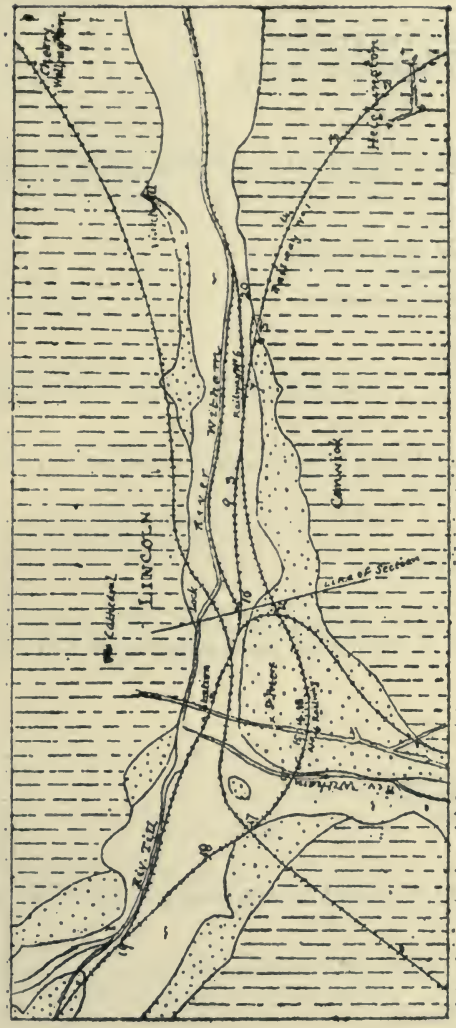
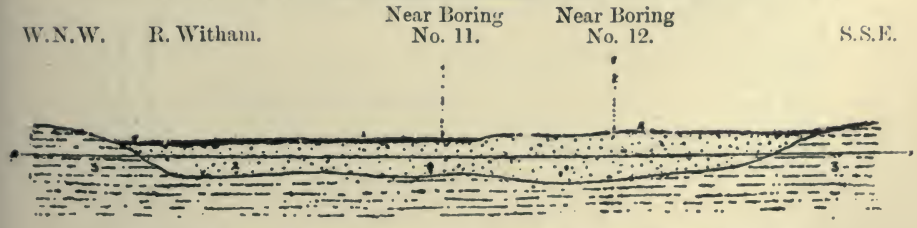


FIG. 3.

Section across the Alluvium of the River Witham, half a mile east of the G.N.R. Station, Lincoln.



Horizontal Scale, 6 inches=1 mile ; vertical scale 5 times exaggerated.

1, Peat and Alluvium. 2, Valley deposits (Estuarine sand). 3, Lias.

× Ordnance Datum.

No. 6 *Boring*, at 35 miles 79 chains 60 feet from Spalding, Railway No. 1. Above Ordnance Datum, 21·01 feet.

	Ft.	in.
Soil	0	6
White stones or loose rock and a little sand	0	10
Yellow sand with water	2	8
Yellow sand and small white stones, with water	3	6
Brown quick-sands	3	4
Hard blue clay	1	8
	12	6

No. 7 *Boring*, at 36 miles 15 chains 49 feet from Spalding, Railway No. 1. Above Ordnance Datum, 14·41 feet.

	Ft.	in.
Boggy soil	1	6
Dirty sand	1	3
Yellow sand and small white rock-stones	1	11
Dirty yellow sand with water	1	4
Brown quick-sands	13	0
Quick-sands and small white rock-stones	3	0
Sharp sand and gravel	1	0
Fine gravel	2	0
Gravel and sharp sand	1	6
Sharp sand and water	5	6
Sharp sand	1	9
Hard blue clay	0	9
	34	6

No. 8 *Boring*, at 36 miles 58 chains 10 feet from Spalding, Railway No. 1. Above Ordnance Datum, 12.52 feet.

	Ft.	in.
Black bog and soil	2	6
Yellow sand	1	0
Quick-sand	18	0
Sharp sand and a little gravel	7	4
Hard blue clay	0	10
	29	8

No. 9 *Boring*, at 36 miles 64 chains 51 feet from Spalding, Railway No. 1. Above Ordnance Datum, 1.32 feet.

	Ft.	in.
Soil	0	6
Black bog	2	0
White sand	0	6
Yellow sand	1	0
Quick-sand	14	0
Sharp sand with some water	3	0
Sharp sand with a little gravel	2	0
Sharp sand and gravel	8	6
Hard blue clay	1	2
	32	8

No. 10 *Boring*, at 37 miles 28 chains 51 feet from Spalding, Railway No. 1. Above Ordnance Datum, 11.91 feet.

	Ft.	in.
Soil and dirty sand	3	6
Yellow sand	1	6
Quick-sand	11	3
Sharp sand and gravel	3	9
Black loam and sand	2	3
Fine sand and very coarse gravel	0	9
Sharp sand and gravel	4	3
Hard blue clay	1	0
	28	3

No. 11 *Boring*, at 37 miles 39 chains 20 feet from Spalding, Railway No. 1. Above Ordnance Datum, 13.43 feet.

	Ft.	in.
Brown bog, etc.	3	3
Black bog	0	9
Dirty sand	0	9
Yellow sand	0	9
White sand	1	3
Quick-sand	9	7
Sharp sand and gravel with some water	1	11
Sharp sand and a little coarse gravel	12	5
Hard blue clay	0	10
	31	6

No. 12 *Boring*, at 65 chains 17 feet from Greetwell Junction, near Canwick, Railway No. 4. Above Ordnance Datum, 16.53 feet.

	Ft.	in.
Clean white sand, etc.	2	4
Brown sand with some water, about	2	8
Clean sharp sand, about	1	0
Fine sand	1	0
Bluish white sand	1	6
Sharp loamy sand	1	6
Fine brown loamy sand	1	0
Quick-sands, about	8	6
Sharp sands and a little gravel	16	3
Hard blue clay	0	11
	36	8

No. 13 *Boring*, at 1 mile 24 chains 62 feet from Greetwell Junction, near Canwick, Railway No 4. Above Ordnance Datum, 10.73 feet.

	Ft.	in.
Reddish sand, etc.	5	6
Gravel	0	9
Red sand	0	9
Soft blue clay and sand	1	0
Sharp sand	5	3
Sharp sand and a little gravel	20	11
Hard blue clay	0	4½
	34	6½

No. 14 *Boring*, at 1 mile 35 chains from Greetwell Junction, near Canwick, Railway No. 4 (on east side of the High Street). Above Ordnance Datum, 22.02 feet.

	Ft.	in.
Dirty sand, etc.	6	0
Shingly sand	0	9
Sandy clay	1	3
Yellow sand	2	0
Quick-sand	10	0
Coarse sand	6	10
Coarse sand with a thin bed of fine gravel	1	2
Coarse sand	3	0
Hard gravel	0	9
	31	9

No. 15 *Boring*, at 1 mile 37 chains 12 feet from Greetwell Junction, near Canwick, Railway No. 4. (on west side of the High Street). Above Ordnance Datum, 21.49 feet.

	Ft.	in.
Dirty sand, etc.	4	6
Clean sand	0	9
Brown sand	0	6
Sharp sand and a little bog	0	3
Dirty sand	1	3
Yellow sand	1	9
Sharp sand and a little gravel with some water	1	0
Sand with some water	6	9
Soft red clay	1	6
Soft red sandy clay	1	6
Soft red clay	0	6
Soft red sandy clay	0	3
Gravel and sand	3	6
Sharp sand and some water	2	0
Sharp sand and a little gravel	13	0
Hard blue clay	0	8
	39	8

No. 16 *Boring*, at 1 mile 53 chains 45 feet from Greetwell Junction, near Canwick, Railway No. 4 (north side of the Witham). Above Ordnance Datum, 12.43 feet.

	Ft.	in.
Dirty sand, etc.	10	6
Dirty yellow sand and gravel	0	6
Sharp sand	1	6
Sharp sand and a little gravel	17	10
Hard blue clay	1	3
	31	7

No. 17 *Boring*, at 1 mile 79 chains 4½ feet from Greetwell Junction, near Canwick, Railway No 4. Above Ordnance Datum, 13.55 feet.

	Ft.	in.
Soil and white sand	2	0
Yellow sand	2	0
Quick-sand	8	0
Sharp sands and gravel	1	0
Sharp sand and a little gravel with some water	2	0
Sharp sand and a little gravel	16	2
Blue clay	0	9
	31	11

No. 18 *Boring*, at 2 miles 18 chains 52¾ feet from Greetwell Junction, near Canwick, Railway No. 4 (north side of Skellingthorpe Drain). Above Ordnance Datum, 12.55 feet.

	Ft.	in.
Soil	0	9
Yellow sand	1	9
Black bog	1	0
Pink sand	1	6
Quick-sand	5	0
Sharp sand and gravel	1	0
Clean fine gravel	1	6
Gravel	0	6
Sharp sand and gravel	15	3
Hard blue clay	1	0
	29	3

No. 19 *Boring*, at 3 miles 10 feet from Greetwell Junction, near Canwick, Railway No. 4. Above Ordnance Datum, 13.72 feet

	Ft.	in.
Surface, etc.	5	0
Brown bog	1	0
Dirty white sand	2	0
Dirty sand	2	9
Sand and gravel	7	9
Sand and a little coarse gravel	1	7
Hard blue clay	0	11
	21	0

No. 20 *Boring*, at 9 chains 52¾ yards from Washingborough Junction, Railway No. 6. Above Ordnance Datum, 8.45 feet.

	Ft.	in.
Soil	0	6
Brown bog	13	6
Dirty white sand	3	0
Dirty sand and gravel	4	0
Sharp sand and gravel and small white "rock-stones"	2	9
Hard blue clay	1	3
	25	0

The pier foundations of the Midland Railway-bridge over the River Witham were carried to a depth of 31 feet, through sand and gravel containing a bed of black peaty clay, 4 or 5 feet thick with freshwater shells.

The cylinders of the railway bridge crossing the High Street in St. Peter's at Gowts were sunk to a depth of 50 feet in the following deposits :—

	Ft.
Made ground	8–10
Sand, upwards of	40
Gravel.	

In the drainage works close by were found :—

	Ft.
Made ground with human bones at the base	6–8
Sand	12–15

In Roby's Foundry two tube-wells proved :—

	Ft.
Made ground	3
Fine silver sand	5
Coarser sand	26
Lias Clay	16
	50

The wells are 3-inch bores, and are 5 yards apart. The yield is 25 gallons per minute from each well, the water standing during dry weather at 5½ feet from the surface of the ground up to which level the sand is water-logged. A. C. G. C.

5. Excavation for a new gas-holder, on west side of the Lincoln and Grantham Line, 1½ furlongs north of the 128th mile post. Noted by Mr. Cameron.

	Ft.
Sand and rubbish	5
Loamy clay, mottled blue and yellow with rootlets, passing into Middle Lias	6
Lower Lias clay with septaria (top of *Ammonites capricornus* zone, according to Mr. W. D. Carr)	4
Lower Lias clay	24
	39

6. Cricket-field, Wragby Road.

	Ft.
Oolitic limestone (a few feet).	
Ironstone	6

Louth.

(1 in. Map, 84 N.S., 103; 6 in. Map, 48 S.W.).

1. Boring at the Waterworks, opposite Thorpe Hall, W.S.W., of Louth Church.

Communicated by Prof. H. Robinson, from a drawing made in December 1871, by Mr. T. W. Wallis, of Louth.

		Ft.	in.
Alluvium, 9 ft.	Silty mould	3	0
	Marl, sand, and clay	6	0
Chalk, 8¾ ft.	White marl or chalk	2	0
	Red marl	1	0
	White marl or chalk	5	9
Red Chalk, 11¼ ft.	Red marl or chalk	7	3
	Softer red chalk and clay	4	0
Carstone, 29 ft.	Yellowish clay and sand	4	0
	Coarse red sandstone	11	0
	Dark reddish sand	6	0
	Yellow sand	8	0
		58	0

Water was found in the Red Chalk from a depth of 17 to 25 feet, but very little came in from the sands below.

2. At the Windmill, half-a-mile N.E. of Church.

Well between 65 and 70 feet deep, entirely through clay into sand, with good water; Chalk not touched.

3. In Little Lane, Mount Pleasant.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

Dug 39 feet, bored 21 feet.

		Ft.
[Glacial Drift]	Red-brown clay, with stones	4
	Silt	1
	Purple clay, with stones	49
	Chalky gravel	3
Chalk rock		3
		60

4. In Victoria Road, near the Railway Station.

Communicated by Mr. Burton (well-sinker), Louth.

Dug 24 feet and bored about 24 feet.

	Ft.
Reddish clay	8
Sand	4
Blue clay	36
[Gravel ?]	?
More than	48

5. At Mr. Kiddell's near Trinity Church.
Communicated by Mr. Burton (well-sinker).

	Ft.
Gravel	15
Clay	30
	45

6. At Mr. Hyde's farm, on the road to Legbourn, a mile and a half S.E. of Louth Church.
Communicated by Mr. Burton (well-sinker).
Water overflows.

	Ft.
Through clay to Chalk	75

7. At houses on road to Legbourn, about a mile and three quarters from Louth Church.
Communicated by Mr. Burton (well-sinker).
Water overflows.

	Ft.
Through clay to Chalk rock	90

8. At a house near the parish Church.
Communicated by Mr. Ch. Wilkinson (well-sinker), of Louth.
Dug 21 feet, bored 24 feet.

		Ft.
[Glacial Drift]	Clay, with "chequers"	27
	Chalky gravel	5
	Blue clay	6
	Sand	2
Chalk and water		5
		45

9. Well by the lamp-post in Eastgate, near the Market Place.
Communicated by Mr. Ch. Wilkinson (well-sinker), of Louth.
Dug 21 feet, bored 24 feet.

		Ft.
[Glacial Drift]	Blue clay, with whites [Purple Clay]	about 39
	Gravel and sand	,, 4
Chalk rock and water		,, 2
		45

Another account of the same well by Mr. J. Bingley, of Aby, makes it 50 feet deep, through dark purple clay into sand.

10. At Mr. Dickie's brickyard, three-quarters of a mile S.S.E. of Louth Church, in the valley.
(1 in. Map, N.S., 103; 6 in. Map, 56 N.W.)
Communicated by Mr. Dickie.

"The well was dug 18 feet, bored 32 feet, in all about 50 feet from the surface to the Chalk rock; through solid marl with small patches of sand here and there, but no regular beds. Water in abundance as soon as the Chalk was tapped."

A well at the brickyard east of the railway-station is said to have been dug 27 feet and bored 30 feet through clay to Chalk.

Luddington.

(1 in Map., 86 N.S. 80; 6 in Map, 10 N.W.)
Sunk in 1875, by Goole Rural Sanitary Authority.
Site close to bed of Old Don River.
Communicated by Mr. E. C. B. Tudor, Surveyor, Goole, to Dr. H. F. Parsons, *Proc. Yorks. Geol. and Polyt. Soc.*, vol. vi. 1877, p. 230).

	Thickness.
Warp	13
Quicksand	12
Clay	12
Sand and Gravel	23

See Analyses, p. 207.

Ludford Magna and Parva.

(1 in. Map, 83 N.S., 103; 6 in Map, 46 S.E.)
1. Walk House, Mr. W. Wingate's.
Communicated by Mr. James Freeborough, well-sinker.

	Ft.
White marl	36
White Chalk rock	18
Red Chalk	6
	60

2. Farm about one mile north of Ludford Parva.

	Ft.
White Chalk rock	54
Red Chalk	6
Red sand [Carstone], about	36
	96

Lusby.

(1 in. Map, 84 N.S., 115; 6 in. Map, 74 S.W.)
House near the main road. Communicated by Mr. Brooks, of Hagworthingham (well-sinker).

		Ft.
Boulder Clay	White clay	30
Spilsby Sandstone	Ragstone	5
	Sand and water	5
		40

Mablethorpe.

(1 in. Map 84, N.S., 104; 6 in. Map, 58 N.W.)
Boring made in 1878.
Communicated by Mr. T. W. Wallis, Surveyor, Louth.
Water rose to within four feet of the surface.

		Ft.
Alluvium 46 feet.	Stiff clay	8
	Softer clay	3
	Buttery clay	8
	Soft black boggy clay	27
Glacial Drift 37 feet.	Stiff clay (Boulder Clay)	20
	Sandy clay	4
	Stiff clay, with small chalk débris	7
	Chalk rubble	6
Chalk	Solid chalk	12
		95

2. Boring made in 1881 near the shore.

Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker).

		Ft.
	Sand (? blown sand)	6
Alluvium 57 feet.	Dark blue silt	45
	Dark brown warp clay	4½
	Grey sand	7½
Glacial Drift 54 feet.	Clay, with chalk stones	18
	Sand, mixed with clay	12
	Clean grey sand	6
	Coarse sand and small gravel	12
	Gravel of chalk and flint	6
Chalk		20
		137

Mr. Harrison says that this boring and that at Theddlethorpe are the deepest two borings he has made in the Marsh. There seems to be a valley or depression in the Chalk here below the Drift. A. J. J. B.

3. At the schools, bored in 1879.

Communicated by Mr. R. Harrison.

		Ft.
Alluvium 28 feet.	Surface clay	4
	Soft warp	22
	Turf	2
Glacial Drift 54 feet.	Dark clay, with small stones	45
	Grey sand	6
	Loose chalk	3
		82

4. At the brickyard, 350 yards N.E. of the Church.

Communicated by Mr. Joseph Jackling, of North Coates (well-borer).

		Ft.
Alluvium 48 feet.	Firm clay	9
	Soft black clay	36
	Sand	2
	Peat	1
Glacial Drift 31 feet.	Marl [Boulder Clay]	30
	Sand	1
Chalk	Hard Chalk	24
		103

5. At Ingoldsby Cottage, bored in 1863.

Communicated by Mr. R. Harrison.

		Ft.
Alluvium 48 feet.	Surface clay	5
	Bluish silt	43
Glacial Drift 60 feet.	Marly clay	24
	Grey sand	36
		108

6. Boring for Great Northern Railway Co.
Communicated by Mr. H. Preston.
Height above O.D. 8 feet.
Water Level 2 feet below surface.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Alluvium.	Yellow clay	15	–	15	–
	Blue clay	3	–	18	–
	Blue clay and peat	3	–	21	–
	Yellow clay	9	–	30	–
	Dark silty clay	24	–	54	–
	Silt	2	–	56	–
Glacial Drift.	Dark clay and white stones	3	–	59	–
	Light (coloured) silty clay	7	–	66	–
	Clay with white (chalk) stones	2	–	68	–
	Light silty clay	9	–	77	–
	Light sand	2	–	79	–
	Darker sand	5	–	84	–
	Light sand	1	–	85	–
	Silty clay	2	–	87	–
	Chalk and clay	5	–	92	–
	Chalk	2	–	94	–
	Silty clay	4	–	98	–
	Sand and chalk	6	–	104	–
	Chalk	2	–	106	–
	Silty clay	2	–	108	–
	Sand and chalk	4	–	112	–
Chalk		2	–	114	–

Maltby-le-Marsh.

(1 in. Map, 84 N.S., 104; 6 in. Map, 57 S.E.)
Near the brickyard, N. of Maltby.
Communicated by Mr. R. Harrison.

		Ft.
Glacial Drift	Clay	52
	Sand (clean)	15
	Sand, with small chalk stones	3½
		70½

Manby.

(1 in. Map, 84 N.S., 103; 6 in. Map, 56 N.E.)
Well at the Hall, bored in 1857.
Communicated by Mr. R. Harrison.

		Ft.
Glacial Drift	Surface soil	1
	Yellow clay	3
	Marly clay, with many pebbles; darker in colour towards the bottom	66
	Sand	8
Chalk	Loose Chalk	4
	Firm Chalk at bottom	3
		85

Markby.

(1 in. Map, 84 N.S., 104; 6 in. Map, 66 N.E.).

1. At Mr. Robinson's.

Communciated by Mr. J. Bingley, of Aby (well-sinker). Dug 15 feet, bored 60 feet.

	Ft.
[Boulder Clay] Clay	63
Sand	3
[Chalk] rock	9
	75

2. At the Rectory.

Communicated by Mr. R. Harrison, of Woodthorpe (well-sinker).

		Ft.
Glacial Drift	Clay [with stones]	57
	Sand (clean)	7
	Sand, with small chalk stones	2
		66

3. At Farm, near Hannah.

Communicated by Mr. R. Harrison.

		Ft.
Glacial Drift	Clay [with stones]	63
	Clean sand	4
	Sand, mixed with chalk	2
		69

Market Deeping.

(1 in. Map, 64 N.S., 158; 6 in. Map, 147 S.W.).

Two-inch boring near centre of town. Made by Mr. J. E. Noble, 1889.

Communicated by Mr. H. Preston.

Height above O.D., 20ft. Water overflows.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	2	0	—	
Drift	Clay	2	6	4	6
	Gravel	13	6	18	0
	Grey sand	3	0	21	0
Oxford Clay	Clay	11	0	32	0
Cornbrash, 8 ft. 5 in.	Rock	2	6	34	6
	Clay	1	6	36	0
	Rock	4	5	40	5
Great Oolite Clay, 10 ft. 7 in.	Clay	1	6	41	11
	Rock	1	3	43	2
	Clay	7	10	51	0
Great Oolite Limestone, 17 ft. 9 in.	Rock	3	6	54	6
	Clay	5	6	60	0
	Rock	8	9	68	9
Upper Estuarine Series	Clay	37	3	106	0
Lincolnshire Limestone	Rock	24	0	130	0

Market Stainton.

(1 in. Map, 83 N.S., 103; 6 in. Map, 64 N.W.).

House near church.

Communicated by Mr. C. Wilkinson (well sinker), Louth.

	Ft
Bored through white clay, with sand below	80

Marsh Chapel.

(1 in. Map, 85 N.S., 90; 6 in. Map, 40 N.E.)

Communicated by Mr. W. Sargent.

		Ft.
Alluvium	Soil and clay	9
	Black mud	21
	Layer of wood	1
	Clay and sand	54
	To Chalk	85

Martin.

(1 in. Map, 83 N.S., 114; 6 in. Map, 87 N.E.).

1. Boring, May, 1896. Communicated by Mr. Jesse Clare, Sleaford. No water.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	2	0	—	
Valley Drift	Gravel	1	7	3	7
Boulder Clay	Clay and chalkstones	31	5	35	0
	Sand rock	1	0	36	0
	Clay with chalk	24	0	60	0
	Red clay	2	0	62	0
Oxford Clay and Kellaways Beds	Blue clay	82	0	144	0
	Shale	1	0	145	0
	Blue clay	16	0	161	0
	Dark flaky clay	18	0	179	0
	Shale	1	0	180	0
	Dark flaky clay	16	0	196	0
	Ditto hard	5	0	201	0
	Limestone rock [Septarium?]	5	6	206	6
	Sandstone	14	6	221	0
	Black clay	8	0	229	0
Cornbrash	Rock, very hard	6	0	235	0
Great Oolite Clay	Coloured clays	18	0	253	0
	Shale	1	0	254	0
	Coloured clay	6	0	260	0
Great Oolite Limestone	Limestone rock, harder and softer bands	36	6	296	6
Upper Estuarine Series	Coloured clay, black, red, and green	10	6	306	6
Lincolnshire Limestone	Rock	102	6	409	0
Upper Lias	Grey marly clay	2	0	411	0

A spring was encountered at 168 feet 6 inches, and water rose 112 feet in boring.

2. At Mr. Goose's farm, Martin Fen, a mile west-south-west from Kirkstead Ferry.

(1 in. Map, N.S., 115; 6 in. Map, 88 N.W.)

Information from Mr. Dobbs, well-sinker, of Kirkstead.

	Ft.
Turfy soil	1
Clean clay	11
Turf with wood and trees	1
Clay	4
Sand	touched
	17

3. At Dobb's Cottage, Martin Fen, half a mile from Kirkstead Ferry. Information from Mr. Dobbs.

	Ft.
Soil and turf	2
Clean clay	11
Turf, with part of an oak tree	1
Clean clay	1
Sand and shingle with rounded pebbles	touched
	15

4. At Mr. Sutterby's farm, Martin North Drove, nine furlongs west of Kirkstead Ferry.

Communicated by Mr. Dobbs.

	Ft.
Soil and turf	1
Clean clay	12
Turf with wood	1
Clay	2
Gravel and sand pierced for	3
	19

5. At Mr. Wilson's half a mile south-west of the last.

Communicated by Mr. Dobbs.

	Ft.
Silt from the surface to	14
Shingle below to	0½
	14½

Mavis Enderby.

(1 in. Map, 84 N.S., 115; 6 in. Map, 82 N.E.).

1. Cottage at corner of road, about 500 yards S.W. of the Church.

		Ft.
Tealby Beds	Yellowish clay	9
Spilsby Sandstone	Sandstone (bored)	30
	Hard "rock-stone" (blasted), with water beneath	1
		40

2. At cottages by North Field Farm, about five furlongs N.W. of Church. Information from Mr. Brown (the tenant).

		Ft
Boulder Clay	Yellow clay, with stones	16
Spilsby Sandstone	Sand with water	7
		23

Metheringham.

(1 in. Map, 83 N.S., 114 ; 6 in. Map, 79 S.E.).

At the farm one mile west-south-west of Engine Farm, Metheringham Fen. Information from Mr. Scholy, occupier.

		Ft.
Alluvium	Turfy soil	1¼
	Clean clay	12
	Gravel and water	2
		15¼

Morton (Bourn).

(1 in. Map 70, N.S., 143 ; 6 in. Map, 132 S.E.).
Boring made by Mr. J. E. Noble for village supply.
Communicated by Mr. H. Preston.
Yield, very strong overflow.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Kellaways Beds	Sand	7 0	—
	Clay	4 0	11 0
Cornbrash	Rock	9 0	20 0
Great Oolite Clay	Clay	19 9	39 9
Great Oolite Limestone	Rock	10 2	49 11
Upper Estuarine Series, 31 ft.	Clay	9 6	59 5
	Rock	3 0	62 5
	Clay	18 6	80 11
Lincolnshire Limestone	Rock	27 1	108 0

2. Two and a half and four-inch borings at Morton carried to depth of 93 feet; water rose 20 feet above surface. J. Addy, *Proc. Inst. C.E.*, lxxiv. (1883), 160.

3. Hanthorpe, half a mile west of Morton. Four-inch boring carried to depth of 168 feet. No water. J. Addy, *op. cit.*

4. Boring made and communicated by Messrs. Barnes & Sharpe, Sleaford. Water was struck at 83ft. 6in : Yield 150 gallons per minute.

		Thickness.	Depth.
	Blue clay	4	4
Cornbrash	Limestone	1½	5½
Great Oolite Clay.	Clay	6½	12
	Rock	1	13
	Clay	12	25
Great Oolite Limestone	Blue rock	10½	35½
Upper Estuarine Series	Clay	4	39½
	Rock	1½	41
	Clay	6	47
	Rock	3	50
	Clay	18	68
Lincolnshire Limestone	Rock	40½	108½

Nettleton.

See p. 207.

Normanton.

(1 in. Map, 70 N.S., 127; 6 in. Map, 105 N.W.).

		Ft.	in.
Middle Lias	Clay	12	0
	Stone	0	2 to 2½
	Clay	18	0
	Stone	0	3
		30	5

Orby.

(1 in. Map, 84 N.S., 116; 6 in. Map, 83 N.E.)

1. House near the Inn, S.E. of the Church.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

Dug 10 feet, bored 35 feet.

		Ft.
Glacial Drift	Clay, with stones	15
	Sand	3
	Clay, with stones	24
	Gravel of small chalk pebbles	3
		45

2. At the Vicarage. Well dug 17 feet, bored 5 feet.

		Ft.
Glacial Drift	Clay, with stones	22
	Gravel, with plenty of water	2
		24

3. At the "Red Lion" Inn there is gravel at a depth of 12 feet.

4. Mr. Grantham's farm, seven furlongs S.E. of Church. Well dug 16 feet, bored 20 feet.

		Ft.
Glacial Drift	Clean clay	about 6
	Marly clay	28
	Gravel	2
		36

5. Habertoft, a mile and a half N.E. of Orby.

Information from Mr. Dawson (the tenant).

		Ft.
Boulder Clay	Clay, with stones	20
	Sand and water	4
		24

Ormsby, South.

(1 in. Map, 84 N.S., 103; 6 in. Map, 65 S.E.).

At cottage opposite Church.

	Ft.
Sunk through stiff clay (Boulder Clay) with stones and veins of sand, water found at bottom	45

Osbournby.

(1 in. Map, 70 N.S., 127; 6 in. Map, 115 S.W.).

1. Boring made in 1884–5.

Communicated by Mr. Jesse Clare, of Sleaford.

Water rises above the surface during part of the year.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil	Loose stones and soil	1 6	1 6
Oxford Clay.	Yellow clay	3 0	4 6
	Dark blue clay	14 6	19 0
Cornbrash.	Cornbrash rock	2 0	21 0
	Dark clay parting	0 2	21 2
	Hard blue rock	2 10	24 0
	Dark clay parting	0 4	24 4
	Hard blue rock	0 10	25 2
Great Oolite Clay.	Soft dark brashy clay	3 0	28 2
	Strong dark blue clay and fossils	21 0	49 2
Great Oolite Limestone.	Hard grey rock	0 10	50 0
	Strong dark blue clay	1 0	51 0
	Very hard blue rock	12 0	63 0
Upper Estuarine Series.	Blue mottled clay	1 6	64 6
	Hard blue rock	0 6	65 0
	Light blue clay	6 0	71 0
	Very hard blue rock	2 0	73 0
	Strong blue clay with fossils	19 6	92 6
Lincolnshire Limestone.	Very hard limestone	7 3	99 9
	Rock band parting	0 2	99 11
	Very hard limestone	30 5	130 4
	Limestone with thin partings	20 6	150 10

2. West end of village.

Information obtained by Mr. W. H. Holloway from the workmen.

		Ft.
Soil		2
Oxford Clay, &c.	Clay	6
	Rock	3
	Dicey clay	16
		27

Owston

(1 in. Map, 86 N.S., 88; 6 in. Map, 25 S.E.).

Communicated by Mr. A. C. G. Cameron.

The relation of the surface deposits at Gunthorpe, as seen in drains appears to be:—

Warp	1 ft. to 15 ft.
Peat	6 in. to 5 ft.

Clay or Warp below again sometimes, but more often sand.

Wells yield hard water, furring kettles, so that Trent water is preferred and greatly used.

Pilham.

(1 in. Map, 83 N.S., 89; 6 in. Map, 35 S.W.).

Well at Farm house, about 300 yards from Blyton Station.
Communicated by Mr. Cressey, well-sinker, Scunthorpe, to Mr. Ussher.

		Ft.
[Boulder Clay]	Clay	12
[Lower Lias]	Pieces of stone, large	6
	Dark clay	6
	Red clay	6
	Blue bind (shale) in which the sinking was abandoned.	

Pinchbeck.

(1 in. Map, 70 N.S., 144; 6 in. Map, 134 N.W.).

1. Railway station, caissons sunk in the river Glen at Herring Bridge.
Communicated by Mr. C. Frow, of Spalding.

		Ft.
Alluvium	Silt and silty sand	6
	Greyish clay with peaty band at bottom	4
	Dark clay becoming peaty at bottom	20
	Peat	1
	Sand	1
Boulder Clay		1
		33

2. At a farm near Parsons Drove, and 300 yards from South Forty-foot Drain, Pinchbeck North Fen.
Communicated by Mr. A. Rose, Bursar of Emmanuel College; from the well-sinker's account. 1885–1886.

		Ft.
[Fen Beds.]	Quicksand and silt	12
[Oxford Clay and Kellaways Beds]	Blue clay	18
	Kale	4
	Blue clay	35
[Cornbrash]	Rock	19
[Great Oolite Clays; 29 feet]	Blue clay	11
	Rock	11
	Mixed clays	7
[Great Oolite Lst.]	Hard blue rock	22
[Upper Estuarine Series]	Mixed clays and peat	31
Lincolnshire Limestone.	Rock	82
		252

Only a small supply of water being obtained at the top of the Lincolnshire Limestone, the bore was carried to its present depth without reaching the base of the rock, and the ultimate yield was from 2,000 to 3,000 gallons a day.

A. J. J. B.

Pointon.

(1 in. Map, 70 N.S., 143; 6 in. Map, 124 S.E.)

1. Three-inch boring to depth of 87 feet (?). Water rose about 20 feet above surface. J. Addy, *Proc. Inst. C. E.* lxxiv. (1883), 160.

2. Crownland, Pointon Fen. (6 in. Map, 125 S.W.)
Communicated by Messrs. Barnes and Sharpe.

		Ft.
Fen Beds	Clay	52
Kellaways Beds	Sandstone	10
	Clay	13
Cornbrash	Rock	6
Great Oolite Clay	Clay	22
Great Oolite Limestone	Rock	10
Upper Estuarine Series	Clay	35
Lincolnshire Limestone	Rock (water)	24
		172

H. B. W.

Ponton, Great.

(1 in. Map, 70 N.S., 143; 6 in. Map, 124 S. E.).
Communicated by Mr. H. Preston (measured).

1. Well at Ponton Heath Lodge.
Height above O.D., 417·6, 3 feet of water.

———	Thickness.	Depth.
	Ft. in.	Ft. in.
Lincolnshire Limestone and Northampton Sands	54 0	—
Upper Lias (Blue) clay	2 9	56 9

2. Well on northern side of Heath Farm.
Height above O.D., 440 feet. Total depth, 69 ft. 4 in.
This well had 4 feet of water and had probably penetrated 3 feet into the Lias Clay.

3. Well at Farm Buildings three-quarters of a mile north of Heath Farm.
Depth of water, 2 feet. Total depth to Lias Clay, 21 feet, 9 in.

Potter Hanworth.

(1 in. Map, 83 N.S. 114; 6 in. map, 79 N.W.)
Communicated by Messrs. Barnes and Sharpe, Sleaford.

Water rose 7 or 8 feet above surface, but subsided to 15 feet below surface. Good supply.

———		Thickness.	Depth.
		Ft.	Ft.
Drift and Great Oolite Clay	Brown clay	8	8
	Blue clay	2	10
Great Oolite Limestone	Rock	30	40
Upper Estuarine Series	Black clay	10	50
	Blue clay	5	55
Lincolnshire Limestone	Rock	18	73
	Rock in hard and soft bands	68	141
	Rock (water)	9	150
	Clay	3	153

See analyses, p. 208.

Quadring.

(1 in. Map, 70 N.S., 144 ; 6 in. Map, 125 N.E.)

At Bannister's Farm, Quadring Low Fen.

Obtained by Mr. S. B. J. Skertchly.

		Ft.
Alluvium	Peat	0½
	Clay	23
	Peat	1½
	Gravel	—
		25

Quarrington.

(1 in. Map, 70 N.S., 127 ; 6 in. Map, 106 S.W.)

1. Bore-hole at the Kesteven County Asylum, in the parish of Quarrington, near Rauceby. Dug well, 9 ft.

Made and communicated by Messrs. C. Isler and Co. 1900.

Water level, 45 feet below surface. Yield about 3,500 gallons per hour.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Made ground	3 0	3 0
Great Oolite Clay	Blue marl	24 0	27 0
Great Oolite Limestone	Blue rock (limestone)	15 0	42 0
Upper Estuarine Series	Blue marl	7 0	49 0
	Blue rock (limestone)	2 0	51 0
	Blue marl	19 0	70 0
Lincolnshire Limestone	Oolite rock	101 6	171 6
Northampton Beds	Blue clay	0 6	172 0
	Blue rock	7 0	179 0
Upper Lias	Blue clay	51 0	230 0

2. Boring on the western side of parish near Rauceby Station, G.N.R., for Kesteven Asylum. Completed June 21st, 1898. 100 feet above O.D.

Communicated by Mr. Jesse Clare, of Sleaford.

Abundant supply of water, which rises to within 42 feet of the surface.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Made ground		2 6	2 6
Great Oolite Clay	Light clay		
	Blue clay	25 6	28 0
Great Oolite Limestone	Hard blue rock	13 0	41 0
Upper Estuarine Series	Blue clay	27 0	68 0
Lincolnshire Limestone	Light soft rock	5 0	73 0
	Hard limestone	8 0	81 0
	White limestone	6 0	87 0
	Blue rock	6 0	93 0
	White limestone	5 0	98 0
	Grey limestone	11 0	109 0
	Blue rock	6 0	115 0
	Grey limestone	5 0	120 0

3. About half a mile south of the Church.

Boring made in 1798-9.

From an account by J. Cragg in Wesburgh's Sketches of Sleaford, 1825.

Water rose to 15 feet above the surface.

		Ft.
	Sandy moory soil	4
Cornbrash	Blue stone rock	7
[Great Oolite Clay, 40¼ feet]	Blue bine of a marbly clay-like appearance, tender and soapy	21
	Stony rock	3
	Stronger blue bine	2
	Brown bine and limestone	4
	Coals (lignite)	½
[Great Oolite and Upper Estuarine Series, 53¼ feet]	Stone of marble-like grit	2
	Chiefly blue stone solid rock	51
	Depth of water bursting out violently, and uniformly running [1825]	¼
[Lincolnshire Limestone and Northampton Sand]	Chiefly solid stone rock with one small mineral spring shown by rust on the boring irons	195
[Upper and Middle Lias Clay]	Chiefly a very hard and uniform bed of blue slaty bine intermixed with a few balls of ironstone and pieces of very strong sulphur [pyrites]	180
		479½

4. Mr. Sharpe's House.

Information from Joseph Cocks, of Sleaford.

Sunk 46 feet. Bored 167 feet. Chiefly through clay and blue rock, the rock being very thick in the lower part.

See Analyses, p. 208.

Raithby by Spilsby.

(1 in. Map 84, N.S.,115; 6 in. Map, 82 N.E.)

Boring for coal on farm occupied by William Hobson.

Farey, in Thompson's Hist. and Antiq. Boston, p. 669.

		Ft.
[Kimeridge Clay, etc.]	Clay with clay-slate (bituminated shale)	312

Rauceby.

(1 in. Map 70, N.S., 127; 6 in. Map, 106 N.W.).

1. Boring on the high road made and communicated by Messrs. Tilley, 1898, to Mr. Whitaker. (See also under Quarrington).

Water at 32, 93, 98, 109, and 115 feet.

———		Thickness.	Depth.
		Ft. in.	Ft. in.
Great Oolite Clay	Light-coloured clay	2 6	2 6
	Blue clay		
Great Oolite Limestone	Hard blue rock	25 6	28 0
Upper Estuarine Series	Blue clay	11 0	39 0

1. Boring on the high road—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Lincolnshire Limestone	Light-coloured soft rock	29 0	68 0
		5 0	73 0
	Hard rock	8 0	81 0
	White limestone	6 0	87 0
	Blue limestone	6 0	93 0
	White limestone	16 0	109 0
	Blue rock	6 0	115 0
	White limestone	5 0	120 0

2. Cottages in the hollow, between North and South Rauceby.

Information from Mr. Bland.

		Ft. in.
[Upper Estuarine Series]	Soil and clay	2 0
	Strong blue and purple clay	3 or 4 0
	Tea-green clay	4 or 5 0
	Skerry	0 4
[Lincolnshire Limestone]	Hard blue shelly rock with a softer marly band	8 0
		About 16 feet.

3. Rauceby Bottom, Gate-house by railway.

Information from Mr. Joseph Cocks.

		Ft.
Valley Gravel.—	Sand and gravel	16
Lincolnshire Limestone.—	White rocks	11
		27

Two feet of water found running through a joint at the bottom, direction 7° S. of E.

4. Mr. Bland's House, South Rauceby.

Information from Mr. Bland.

		Ft. In.
Upper Estuarine Clays.	Soil	2 0
	Rock	0 6
	Loamy clay	3 6
	Rock	1 3
	Loamy clay	3 6
	Blue rock	2 0
	Loamy clay	2 0
	Sandy rock with carbonaceous markings	1 6
		15 3

Reston, South.

(1 in. Map 84, N.S., 103; 6 in. Map, 56 S.E.)

At the brickyard, bored in 1870.

Communicated by Mr. Robt. Harrison, of Woodthorpe (well-sinker).

		Ft.
[Glacial Drift]	Soil, &c.	3
	Clay, with small stones	25?
	Grey sand, with very small gravel	3
	Dark clay, with stones	26
	Grey sand	8
		65

Rippingale.

(1 in. Map 70, N.S., 143; 6 in. Map 132, N.E.)

4 in boring to depth 130 feet. Plentiful supply by lift-pump.
J. Addy, *Proc. Inst. C. E.* lxxiv. (1883), 160.

Roxby-cum-Risby.

(1 in. Map 86, N.S., 80; 6 in. Map, 11 N.W.).

Mostly shallow wells.

1. Well at High Risby.

	Ft.
Lincolnshire Limestone.—All rock (limestone and greystone)	45

2. Well at Roxby.

	Ft.	in.
Lincolnshire Limestone.—Limestone	2	0
Lower Estuarine Series.—White and red sand	16	0
	18	0

3. Boring at Roxby.

	Ft.	in.
Lincolnshire Limestone.—Rock	4	0
Lower Estuarine Series.—Measures to blue clay (Lias)	40	0

4. Well at Roxby Grange.

		Ft.	in.
[Lower Estuarine Series]	Soil	2	0
	Gravelly stuff (probably broken rock)	9	0
	Shale	4	0
	Greystone, very hard	0	6
		15	6

See Analyses, p. 209.

5. Boring at S.E. corner of Risby Warren.

Communicated by Mr. H. Preston from information supplied by Mr. A. McD. Cobban, Scunthorpe.

Height above O.D. 52 feet. Water overflows at surface. Yield 75,000 gallons per day when pumped to a rest-level of 19 feet.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Sandy soil	4	0	4	0
	Gravel	5	0	9	0
	Clay	1	0	10	0
	Limestone, with water	6	0	16	0
	Soft clayey limestone	3	6	19	6
	Soft limestones	5	0	24	6
	Hard limestone, with water	5	0	29	6
	Hard dense limestone	7	0	36	6
	Soft shaly limestone	3	0	39	6
	Hard limestone	4	0	43	6
Lincolnshire Limestone	Clays and limestones	17	0	60	6
	Very hard rock, with water	4	0	64	6
	Soft clay	6	0	70	6
	Rocky limestone	2	0	72	6
	Blue clay	7	0	79	6
	Rocky limestone	1	0	80	6
	Blue clay	1	0	81	6
	Rocky limestone	10	5	91	11

Rothwell.

(1 in. Map, 86 N.S., 90; 6 in. Map, 38 N.W).

At the farmstead one mile E.N.E. of the church.

Information obtained from the foreman by Mr. A. J. Jukes-Browne, and from specimens, on the spot.

		Ft.
	Soil and earth	4
	Gravel of small chalk pebbles	16
Red Chalk	Clean red clay	1
Carstone.	Small pebbly sand Hard rock	8
		29

Ruckland.

(1 in. Map 84, N.S., 103; 6 in. Map 65, N.W.).

At the Vicarage.

	Ft.
Sunk through grey Chalk into Red Chalk	28

Ruskington.

(1 in. Map 70, N.S., 127; 6 in. Map 97, S.E.).

1. Shallow wells in gravel and sand. (*6th Report Rivers Poll. Comm.*, 1874, p. 390).

2. Good water has been obtained at a depth of about 120 feet at Ruskington, whence it rises above the surface; and fair water has been met with about 200 feet deep in Ruskington Fen. (J. Clare, 1893.)

3. Communicated by Messrs. Barnes and Sharpe, Sleaford.

Water rose above surface; very good supply.

		Ft.	in.
	Soil	3	0
Valley Gravel	Gravel	5	6
Kellaways Beds	Sandstone	21	6
Cornbrash	Rock	10	0
Great Oolite Clay	Clay	26	0
Great Oolite Limestone	Rock	15	0
Upper Estuarine Series	Clay	4	6
	Rock	5	6
	Clay	14	0
Lincolnshire Limestone	Rock	5	10
		110	10

See Analyses p. 210.

Saleby.

(1 in. Map 84, N.S., 104; 6 in. Map, 66 N.E.)

1. At the Vicarage.

Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker).

		Ft.
[Glacial Drift]	Clay with [stones]	59
	Sand	12
	Sand, with flints	2
		73

2. At Mr. Farrar's.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

		Ft.
[Glacial Drift]	Clay with stones	67
	Gravel	6
[Chalk]	Rock	10
		83

3. Well at Mr. Riggall's pierces clay 66 feet, and gravel 9 feet, finding a supply of water without touching the Chalk.

Saltfleet.

(1 in. Map 84, N.S., 91; 6 in. Map 41, S.E.).

Average thickness of beds down to the surface of the Chalk in wells near Saltfleet.

Communicated by Ch. Wilkinson (well-borer), of Louth.

	Ft.
Warp clays	24
Stony brown clay [Boulder Clay]	60
Sand with sea-shells	2
Chalk.	

Saltfleetby.

(1 in. Map 84, N.S., 104; 6 in. Map, 49 N.E.).

1. At the railway station, half a mile west of Saltfleetby All Saints.
Communicated by Mr. W. H. Kirkby, Louth.

		Ft.
Alluvium	Soft black soil [Clay and Silt]	42
Glacial Drift	Hard red clay [Boulder Clay]	28
	Sand	2
Chalk	White chalk [and ? Red Chalk]	18
[Carstone ?]	Sand	35
		123

Water was found about midway in the Chalk, at a depth of 80 feet from the surface. It is possible, however, that the Chalk is a detached mass, and that the sand below is Glacial. A. J. J. B.

2. At the brickyard three-quarters of a mile S.W. of Saltfleetby St. Peter Church.
Communicated by Mr. J. Cannon (proprietor).
Dug 30 feet, bored 66 feet.

		Ft.
Alluvium	Brown and black clays	10
	Turf, with trees	0¾
	Sandy clay, with flint stones	2
Boulder Clay	Marl, full of whites	74
	Croy and Chalk	10
		96¾

3. Boring at Railway Station, on Louth and Mablethorpe Branch.
Made for the Great Northern Railway Company, 1883.
Communicated by Mr. H. Preston.

		Thickness.	Depth.
		Ft.	Ft.
Alluvium	Soft black earth	42	42
Glacial Drift	Hard red clay	81	123
	Sand	2	125
Chalk	White chalk (water)	18	143
Carstone	Sand	35	178

Scawby.

(1 in. Map 86, N.S., 89; 6 in. Map, 27 N.E.).

1. Well at Mr. Foster's, Mill Place, at the turning from the Brigg and Hibaldstow road to Castlethorpe.
Communicated to Mr. Ussher by Mr. Cressey, well-sinker, Scunthorpe.

		Ft.	in.
Lincolnshire Limestone	Yellowish brashy stone (base of the Hibaldstow Beds)	7	0
	Clay	4 ft. to 5	0
	Dark blue stone.		
	Hard limestone.		

2. Boring for Ironstone, by the Railway, half a mile south-west of Scawby Station.

Communicated by Mr. Charles Hett, of Brigg.

			Ft.	in.
Lincolnshire Limestone	[Hibaldstow Beds] Limestone		5 feet to 6	0
	Kirton Beds.	Clay	4	0
		Rock	2	0
		Clay	9	0
		Rock	1	0
		Clay	18	8
		Rock	1	6
		Clay	2	5
		Rock	11	0
Lower Estuarine Series and Upper Lias	Clay		57	0
	Stone		1	0
	Shale		92	6
Middle Lias	Rock very hard (probably Ironstone)		7	0
			213	1

The want of detail in this boring forbids the correlation of the beds with any degree of certainty. It is probable that limestones occur in the 18 feet 8 inches of clay, as such a development in the Kirton Beds is abnormal.

W. A. E. U.

Scothern.

(1 in. Map 83, N.S., 102; 6 in. Map, 62 N.W.).

Well at Scothern Grange.

	Ft.
Boulder clay	7
Gravel, with water	
	7

Scotter.

(1 in. Map 86, N.S., 89; 6 in. Map, 26 S.E.)

Water obtained from shallow wells.

Scredington.

(1 in. Map 70, N.S., 127; 6 in. Map, 115 N.E.).

1. Mr. Clarke's.

Information from Joseph Cocks.

Sunk 46 feet, and bored 56 feet. Water found in the silt at the bottom and rose to within 43 feet of surface.

2. Boring by side of roadway in village, 35 feet above O.D. Water overflowed.

Communicated by Messrs. Tilley to Mr. Whitaker, July, 1897.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay and Kellaways Beds.	Clay	97 0	97 0
	Rock	2 0	99 0
	Clay	4 0	103 0
	Hard sandy clay	2 0	105 0
	Clay	2 0	107 0
	Loamy sand	14 0	121 0
	Clay	2 6	123 6
Cornbrash	Rock	5 0	128 6
Great Oolite Clay.	Dark clay	1 6	130 0
	Coloured clay	7 0	137 0
	Dark clay	14 6	151 6
Great Oolite Limestone	Rock	12 0	163 6
Upper Estuarine Series. 32 feet.	Mixed clay (green, etc.)	4 0	167 6
	Dark clay	2 6	170 0
	Mixed clay	4 0	174 0
	Rock	3 0	177 0
	Green clay	3 0	180 0
	Dark clay	6 0	186 0
	Slate coloured clay	7 0	193 0
	Dark clay	3 0	196 0
Lincolnshire Limestone.	Rock	23 0	219 0

Scremby.

(1 in. Map 84, N.S., 116; 6 in. Map, 83 N.W.).

1. At. Mr. Forster's house, a quarter of a mile S.E. of the Church.

Information from Mr. Woods (well-sinker), Scremby. Water rises to the surface.

		Ft.
Glacial Drift	Brown clay, with chalk and stones, dug for	16
	Bored through same into chalky gravel	17
		33

2. Well in farmyard, a quarter of a mile north of the Church.

Information from Mr. Woods.

		Ft.
Tealby Beds	"Roach," a loamy clay, or soft ironstone	40
	Red sand, with water	

Scunthorpe.

(1 in. Map 86, N.S., 89; 6 in. Map, 18 N.E.).

Boring 1½ miles west of village. Made by Messrs. Vivian and Company. 1898–1901.

Communicated by Mr. W. Gibson from information afforded by Mr. A. McDonald Cobban, resident engineer.

Note by Mr. Preston, from information given by Mr. A. McD. Cobban:—Lining tubes were put in to a depth of 1,567 feet, all water above this point being excluded. Pumping tests were made and continued for fourteen days and nights, with the result that 300,000 gallons per twenty-four hours were obtained. This pumping reduced the flow from a slight Artesian head to a level of 160 feet down. Upon analysis the water was shown to be organically pure, but so excessively loaded with saline constituents as to render it unfit for a town supply (*see* Analysis, p. 211).

		Thickness.	Depth.
		Ft. in.	Ft. in.
Superficial deposits, 21 ft. 5 in.	Soil	1 0	1 0
	Loamy sand	3 0	4 0
	Running sand	14 4	18 4
	Peat	0 6	18 10
	Running sand	2 7	21 5
Rhætic Beds and passage beds to Keuper Marls, 19 ft. 7 in.	Soft blue and dark grey marl [thin black shales with bone-bed]	0 11	22 4
	Dark grey and blue marl	1 1	23 5
	Dark grey and blue marl with sulphur band	0 6	23 11
	Blue marl	17 1	41 0
Keuper. Marls, 845 feet.	Red marl	0 4	41 4
	Red and blue marl	2 3	43 7
	Red marl	13 8	57 3
	Red and blue marl	21 5	78 8
	Gypsum and marl	2 10	81 6
	Red and blue marl and gypsum	131 8	213 2
	Red marl and gypsum	28 1	241 3
	Red and blue marl and gypsum	8 9	250 0
	Red and blue marl and gypsum with hard stones	80 0	330 0
	Red and blue marl and gypsum	137 4	467 4
	Blue marl and gypsum	6 0	473 4
	Red and blue marl and gypsum	412 8	886 0
Keuper Sandy Beds (probably equivalent to Waterstones)	(Gradual passage of marl into sandstone)		
	Grey sandstones and marl	4 0	890 0
	Red sandstone	68 6	958 6
	Red sandy marl	1 6	960 0
	Red sandstone	44 6	1004 6
	Red sandstone with mica joints and pieces of marl	7 6	1012 0
	Red sandstone	5 6	1017 6
	Red sandstone with grey joints and pieces of marl	8 6	1026 0

Boring 1½ miles west of village—*continued*.

—		Thickness.	Depth.
		Ft. in.	Ft. in.
Keuper Sandy Beds (*continued*) (probably equivalent to Water-stones) 225 ft. 6 in. (? base)	Red and blue sandy marl	1 8	1027 8
	Red sandstone	26 10	1054 6
	Red sandstone with small pebbles	10 6	1065 0
	Red and blue sandy marl	1 6	1066 6
	Red sandstone with small pebbles	39 3	1105 9
	Grey sandstone with small pebbles	2 0	1107 9
	Red marl	2 3	1110 0
	Grey sandstone	1 6	1111 6
Keuper Sandstone, 441 ft. 6 in.	Red sandstone and small pebbles	15 0	1126 6
	Red sandstone with small pebbles and marl	11 9	1138 3
	Red sandstone and few small pebbles	32 3	1170 6
	Red sandstone with grey joints	15 0	1185 6
	Red sandstone with pieces of marl	12 0	1197 6
	Red sandstone with pebbles	47 9	1245 3
	Red sandstone with pebbles and pieces of marl	3 9	1249 0
	Red sandstone and pebbles	2 2	1251 2
	Red sandstone and pebbles, band of marl	1 0	1252 2
	Red sandstone and pebbles, grey joint	0 7	1252 9
	Red sandstone and pebbles, marl	4 6	1257 3
	Grey sandstone	0 6	1257 9
	Red marl	2 0	1259 9
	Red and blue marl	4 6	1264 3
	Red sandstone	19 0	1283 3
	Red sandstone with marl joints and nodules	48 9	1332 0
	Red marl	0 6	1332 6
	Red sandstone (6-in. marl between 1350½ and 1357½)	38 0	1370 6
	Red marl	1 0	1371 6
	Red sandstone with grey joint below marl	146 0	1517 6
	Sandstone with mica joints and occasional nodules of marl	35 6	1553 0
Bunter ? 196 ft. 11 in.	Red sandstone with mica joints and occasional nodules of marl and pebbles	21 9	1574 9
	Red sandstone	5 6	1580 3
	Red sandy marl	2 0	1582 3
	Red sandstone with pieces of marl and pebbles	32 9	1615 0
	Red sandstone, pieces of marl and pebbles (inrush of water about 1639 ft., 2-in. band red marl at about 1673 ft.)	118 1	1733 1
	Grey sandstone and 5-in. band red marl	1 8	1734 9
	Red sandstone and marl	9 3	1744 0
	Red sandstone, marl and pebbles	5 11	1749 11
	(Full depth reached)	—	1767 6

Silk Willoughby.

(1 in. Map 70, N.S., 127; 6 in. Map 106, S.W.)

1. Boring on land in occupation of Mr. Doncaster on property of the Earl of Dysart.

Communicated by Messrs. Wadsley & Son, of Horbling, 1891.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Clay and soil	8	0	8	0
Cornbrash	Rock	3	0	11	0
Great Oolite Clay	Blue clay	20	0	31	0
Great Oolite Limestone	Rock	17	0	48	0
Upper Estuarine Series	Kale [*i.e.* hard shale]	2	0	50	0
	Soft rock	5	0	55	0
	Clay	17	0	72	0
	White kale	2	0	74	0
Lincolnshire Limestone	Oolite	104	0	178	0
Upper Lias	Lias	20	0	198	0
	Blue rock [? hard shale]	17	9	215	9

2. Mr. Sharp's brickyard near Mareham Grange.
Information from Mr. J. Cocks of Sleaford.
Sunk 33 feet; bored 66 feet. All clay and "dice" (Oxford Clay).

Sixhills.

(1 in. Map 83, N.S., 103; 6 in. Map 54 N.E.)
At Mr. Drake's, close to the church.
Communicated by Mr. James Freeborough, well-sinker.

		Ft.
Glacial Drift	White marl, about	17
	Blue clay with chalk	30
		47

Skegness.

(1 in. Map 84, N.S., 116; 6 in Map 84, S.E.).

1. Waterworks. Made by Messrs. Le Grand and Sutcliff and Messrs. S. F. Baker & Sons. Date 1883.
Communicated by Mr. S. Coetmore Jones, with notes by Mr. A Strahan.
Height above O.D. 10¼ feet; water rose from Grey Sand at 321 feet to 6 feet above surface; yield, 8 gallons a minute.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Alluvium 32½ ft.	Surface soil	3	6	3	6
	Loamy clay	2	0	5	6
	Black and brown mud	27	0	32	6
Glacial Beds 18½ ft.	Brown clay with stones	2	3	34	9
	Dry gravel	1	3	36	0
	Brown clay	8	6	44	6
	Dry sand and gravel	6	6	51	0

4. Waterworks—*continued.*

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Chalk 33 ft.	Chalk rock with salt water	10	0	61	0
	Chalk rock without water	11	0	72	0
Red Chalk	Red chalk or marl	12	0	84	0
Carstone 17½ ft.	Red marl and sand	8	0	92	0
	Dead greensand	6	0	98	0
	Fine dark greensand	2	0	100	0
	Loamy greensand	1	6	101	6
Roach Beds 28½ ft.	Hard light coloured clay	6	6	108	0
	Blue clay	8	6	116	6
	Sandstone & shale (first water found)	13	6	130	0
Tealby Beds 188 ft.	Pale greenish clays with silty bands, scattered grains of oolitic iron oxide occur throughout	96	0	226	0
	Pale bluish grey clay, with small white shell fragments. [At 246 ft. glauconitic green sand: at 263 brown clay slickensided: at 269 bright green glauconitic sand]	43	0	269	0
	Green silt and clay	17	0	286	0
	Greyish blue clay [iron-ore at 288½ and 290]	4	0	290	0
	Buff and pinkish silt becoming brown below and containing oolitic grains of iron oxide [earthy iron-ore with quartz grains at 295]	5	0	295	0
	Tough blue clay with grains of quartz	2	0	297	0
	Light blue clay with fine white sand	2	6	299	6
	Stone band	0	6	300	0
	Hard dark blue clay [light silty clay at 303]	10	0	310	0
	Light blue clay and silt	6	0	316	0
	Stone band	0	6	316	6
	Hard light coloured clay	1	6	318	0
Spilsby Sandstone 19 ft.	Stone band with iron pyrites [limestone at 319½]	1	0	319	0
	Grey sand (second water found at 321 ft.) [limestone at 321]	2	0	321	0
	Brown sand and sandstone with thin clay bands containing grains of iron oxide and shell fragments (*Pecten cinctus* and *Belemnites*)	10	0	331	0
	Greenish sand containing grains of iron-ore, with a pale blue stony band, containing specks of iron pyrites	7	0	338	0

1. Waterworks—*continued.*

		Thickness.	Depth
		Ft. in.	Ft. in.
(Age doubtful) 23 ft. probably Kimeridge Clay	Pale-blue clay, with a hard stone band, containing fragments of shells, specks of iron-pyrites and ? oolitic grains of iron-oxide (? from above) - -	23 0	361 0
Kimeridge Clay	Dark blue clay, with bivalves and Ammonites - - -	42 0	403 0

A fresh boring was made in 1903, and the notes in square brackets have been added from specimens sent by Mr. Jones and examined by Mr. H. B. Woodward and Mr. A. Strahan.

The yield at 321 feet was in September, 1903 at the rate of 2,300 gallons per hour ; but in November, 1903, the average yield proved to be no more than 1800 gallons per hour,

2. Waterworks. Date 1886.

Communicated by Mr. Crawford (foreman in charge) to Mr. Whitaker.

See Jukes-Browne, *Quart. Journ. Geol. Soc.*, vol. xlix., p. 472.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Marsh Beds 34 feet.	Made ground - - - -	1 6	1 6
	Loamy clay - - - -	7 6	9 0
	Black and brown mud - - -	25 0	34 0
Glacial Deposits 16½ feet.	Brown clay, with stones - -	4 0	38 0
	Dry gravel - - - -	1 0	39 0
	Brown clay, with stones - -	5 6	44 6
	Dry dead sand and rock - -	6 0	50 6
Chalk	Rock-chalk - - - -	21 0	71 6
Red Chalk	Red marl - - - -	20 0	91 6
Carstone	Green sand - - - -	10 0	101 6
Roach 28½ feet.	Light coloured clay - - -	8 0	109 6
	Blue clay - - - -	7 0	116 6
	Ironstone shale - - - -	13 7	130 1
Tealby Beds.	Pale blue and grey clays - -	69 11	200 0
	Hard dark-blue clay - - -	1 0	201 0
	Brown and blue clay - - -	10 0	211 0
	Hard clay - - - - -	9 0	220 0
	Clay and sand - - - -	6 0	226 0
	Blue clay, sand and shells - -	18 0	244 0
	Clay and sand, fossils - - -	1 0	245 0
	Sand - - - - - -	2 0	247 0
	Clay and sand - - - - -	14 0	261 0
	Hard brown clay and stones [?septaria]	3 0	264 0
	Blue clay, sand and fossils - -	9 0	273 0
	Clay and fossils - - - -	7 0	280 0
	Blue clay - - - - -	8 6	288 6
	Brown clay - - - - -	0 6	289 0

2. Waterworks—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Tealby Beds 191 feet.	Brown clay and stone	1 0	290 0
	Brown clay and soft sandstone	6 0	296 0
	Blue clay and fine white sand	6 0	302 0
	Hard stone	0 6	302 6
	Hard dark-blue clay	10 6	313 0
	Light-blue clay and silt	6 0	319 0
	Stone band	0 6	319 6
	Hard light-coloured clay	1 6	321 0
Spilsby Sandstone 26 feet.	Grey sand, with water	2 0	323 0
	Brown sand and sandstone	10 0	333 0
	Sandstone	4 0	337 0
	Grey sandstone	8 0	345 0
	Hard stone	2 0	347 0
Kimeridge Clay 78 feet.	Clay-stone	1 0	348 0
	Hard blue clay	15 0	363 0
	Light-blue clay, with flints [?septaria]	1 0	364 0
	Blue clay and fossils	40 0	404 0
	[Not described]	9 0	413 0
	Blue clay and fossils	2 0	415 0
	Blue clay, fossils, and black-brown dirt	10 0	425 0

The "red marl" (71½ to 91½ ft.) probably includes pink as well as true Red Chalk, and possibly some Carstone mixed with red marl carried down by the boring tools. A sample from 297 feet was a hard oolitic marlstone with grains of iron-peroxide.

3. Boring at Seathorne (Nottingham and Notts.) Convalescent Home. By sea, 2,550 yards north-east of Skegness Waterworks. 1902.

Communicated by Mr. S. Coetmore Jones.

Height above O.D. 16 feet.

———		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvium and Glacial Drift	Sand	8 0	8 0
	Mud and sand	40 0	48 0
	Shells and sand	6 0	54 0
	Black sand	20 0	74 0
Chalk	Chalk	94 0	168 0
Red Chalk	Red clay	15 0	183 0
Carstone	Black sand	20 0	203 0
Roach and Tealby Beds	Green sand; N.B. Fresh water found here	6 0	209 0
	Black sand	13 0	222 0
	Unrecorded strata	15 0	237 0
	Dark grey sandstone	4 0	241 0
	Dark blue stone	4 0	245 0
	Blue, brown and green clay	130 0	375 0

3. Boring at Scathorne—*continued*.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Tealby Beds	Soft brown rock	3 0	378 0
	Brown clay	1 0	379 0
	Very hard rock	1 6	380 6
	Clay	19 0	399 6
Spilsby Sandstone	Grey sandstone	28 6	428 0
Kimeridge Clay	Clay	18 0	446 0

When the boring was 270 feet deep the water stood at 26 feet from the surface, when it was 321 feet deep the water level was 18 feet from the surface, and there seems to have been a very considerable increase of water at about 400 feet.

Skendleby.

1. Skendleby Salter.

(1 in. Map 84, N.S. 116; 6 in. Map, 75 S.W.)

Information from Mr. Belton (tenant).

	Ft.
Dug in a hard rock like ironstone	104

No spring was reached here, but water trickles in from the side some way down. The lower part is probably in hard clay, as in well No. 2.

2. At cottage on Mr. Higgin's farm, Skendleby Salter, half a mile east of last.

Communicated by Mr. Ch. Wilkinson, of Louth (well-sinker).

Dug 22 yards, bored 30 yards.

		Ft.
	Chalk rubble	6
Carstone	Brown soft sandstone [? and ironstone]	24
Tealby Beds	Black clay, dug for	126
		156

Two large oyster-shells were found at the bottom of the dug well; no spring reached in the boring. Mr. Tyson, of Willoughby, describes a bed of hard bluish rock, drying grey and flaky, "with silvery chips in it," as occurring in this well, probably at the base of the sandstone.

Sleaford.

(1 in. Map 70, N.S. 127; 6 in. Map, 106 N.E.).

1. Farey mentioned in 1808 that a boring was made "in search of coals some time ago, about 1½ miles from Sleaford, by the side of the road towards London, which at a great depth tapped so powerful a spring, that the same has ever since boiled up a considerable height above the ground and given rise to a small brook."*

* Extract from letter to Sir Joseph Banks, printed in Thompson's History and Antiquities of Boston, 1856, p. 671.

2. Four-inch boring to depth of 120 feet. Water rose above surface.
J. Addy, *Proc. Inst. C.E.*, lxxiv. (1883), 161.

3. Mr. Chamberlain's, West Street.
Information from Mr. J. Cocks (well-sinker).

		Ft.	in.
[Oxford Clay]	Dicey clay - - - - - about	20	0
[Cornbrash]	Rock in bands and courses and blue rock -	4	6
		24	6

4. Mr. Fearey's, Queen's Head, Westgate.

		Ft.	in.
[Oxford Clay]	Dicey clay - - - - - about	14	0
[Cornbrash]	Shelly rock ("Kale") - - about	1	3
		15	3

5. Mr. Sharpe's Farm, outside the railway-gates. Sunk 33 feet, bored for 62 feet.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Cornbrash	Soil and yellow rubbly rock -	3	2		
	Blue rock - - - -	1	2		
Great Oolite Clay	Clay - - - - -	3	4		
	Blue rock - - - -	1	4		
	Clay and marl - - -	4	6		
	Blue rock - - - -	1	6		
	Similar alternations of clay and rock to the bottom about	80	0	95	0

6. Boring at Messrs. Bass & Co.'s Maltings.
Communicated by Messrs. Le Grand and Sutcliff, who deepened the boring from 113 feet.

Good spring at 156 feet which rose 13½ feet above the surface, with a flow of over 12,000 gallons an hour. On being deepened to 177 feet the bore yielded 30,000 gallons per hour. 1892.

		Thickness.		Depth.	
		Ft.	In.	Ft.	In.
Surface Soil - -	Soil - - - -	1	6	1	6
Valley Gravel - -	Gravel and sand - -	12	0	13	6
Kellaways Beds -	Clay - - - -	1	0	14	6
Cornbrash - -	Rock - - - -	10	0	24	6
Great Oolite Clay -	Clay - - - -	24	0	48	6
Great Oolite Limestone - - -	Rock - - - -	12	0	60	6
Upper Estuarine Series	Clay - - - -	7	0	67	6
	Rock - - - -	2	6	70	0
	Green clay - - -	1	0	71	0
	Dark clay - - -	4	0	75	0

6. Boring at Messrs. Bass & Co's Maltings—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Lincolnshire Limestone	Rock	15 0	90 0
	Clay	2 9	92 9
	Hard grey rock	33 3	126 0
	Hard grey rock and clay in layers	12 6	138 6
	Hard grey rock	6 6	145 0
	Grey shelly rock	32 0	177 0

7. Well in the Cross Keys Yard.
Communicated by Mr. Jesse Clare, of Sleaford.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvium and Valley Gravel	Made ground	2 6	2 6
	Black peat	3 6	6 0
	Gravel and running sand	11 0	17 0
Great Oolite Clay	Scaly rock	1 6	18 6
	Blue clay hard and tough	4 6	23 0
Great Oolite Limestone	Blue rock	11 0	34 0
Upper Estuarine Series	Clay	9 0	43 0
	Rock	2 0	45 0
	Clay	25 0	70 0
Lincolnshire Limestone	Rock with water	7 0	77 0
	Rock with more water	4 6	81 6

8. Boring at the Great Northern Railway Station.
Communicated by Messrs. Le Grand and Sutcliff.

Water rose to 6½ feet above the surface and overflows at the rate of 20,000 gallons per hour.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil	Clay	1 6	1 6
Valley Gravel	Sand	2 0	3 6
	Ballast	12 0	15 6
Great Oolite Limestone	Soft stone	2 6	18 0
	Hard stone	4 0	22 0
Upper Estuarine Series	Hard clay	8 0	30 0
	Stone	1 6	31 6
	Hard clay	16 6	48 0
Lincolnshire Limestone	Stone rock (a sample sent is a grey oolitic limestone)	38 6	86 6
	Rock and layers of clay	2 6	89 0
	Rock oolitic	24 0	113 0
	Rock and thin layers of clay	4 0	117 0
	Rock	34 0	151 0

9. On the estate of the Marquis of Bristol, half-way between Sleaford and Holdingham.

Boring made and communicated by Messrs. Barnes and Sharpe.

Yield, a fine supply, rising from 1 foot below to 5 or 6 feet above the surface.

		Thickness.	Depth.
		Ft.	Ft.
Cornbrash	Stone	10	10
Great Oolite Clay	Blue Clay	28	38
Great Oolite Limestone	Rock	12	50
Upper Estuarine Series	Clay	5	55
	Rock	3	58
	Mottled clay	21	79
Lincolnshire Limestone	Oolite	39	118

10. On the estate of the Marquis of Bristol: water-cress beds, one mile east of Sleaford, 1900.

Communicated by Messrs. Barnes and Sharpe.

Water rushed up in great force through 6-inch bore-hole and rose 20 feet above ground. Yield, 184,500 gallons a day.

		Thickness.	Depth.
		Ft.	Ft.
Valley Drifts	Black soil	2	2
	Red running sand	3	5
	Blue silt	14	19
Cornbrash	Hard blue rock	2	21
Great Oolite Clay	Scaly rock	4	25
	Dry tough silt	16	41
Great Oolite Limestone	Blue rock	8	49
	White rock	½	49½
	Blue rock	4½	54
Upper Estuarine Series	Hard blue clay	20	74
	Black rock	2	76
	Blue clay	2	78
	Very hard rock	7	85
	Soft and jointed rock	3	88
	Hard blue rock	2½	90½
	Blue and green clay	10	100½
Lincolnshire Limestone	Hard blue rock	12	112½
	Shingle and gravel [broken rock]	3	115½
	White rock	1	116½
	Blue rock	2	118½
	Rock (water)	5½	124

11. Boring made and communicated by Messrs. Barnes and Sharpe, Sleaford. Yield, 27,000 gallons per hour. Water rises about 9 feet above ground level.

		Thickness.	Depth.
		Ft.	Ft.
	Soil	2	2
	Gravel and sand	4	6
Cornbrash	Stone	9	15
Great Oolite Clay	Mottled clay	24	39
Great Oolite Limestone	Stone beds	13	52
Upper Estuarine Series	Blue clay	6	58
	Rock	2	60
	Clay	20	80
Lincolnshire Limestone	Oolite	13	93

Somerby.

(1 in. Map 70, N.S., 143; 6 in. Map, 123 N.W.).

Old Somerby Manor House.

Information obtained by W. H. Holloway.

		Ft.
Lincolnshire Limestone.	Limestone rock	nearly 100

Somercotes, North.

(1 in. Map 84, N.S., 91; 6 in. Map, 41 S.W.).

Communicated by Mr. Ch. Wilkinson (well-sinker).

		Ft.
Alluvium, 58 ft.	Reddish clay	4
	Black moor and sand	50
	Sand and shells	4
Glacial, 44 ft.	Layers of red clay, sand, and gravel	44
Chalk, soft at the top with "greystone" at the bottom		40
		142

Somercotes, South.

(1 in. Map 84, N.S., 91; 6 in. Map, 41 S.W.).

1. Communicated by Mr. Joseph Jackling (well-borer), of North Coates.

		Ft.
Alluvium, 52 ft.	Firm clay	18
	Soft black clay	30
	Sand	4
Glacial, 34 ft.	Firm clay	12
	Sand	6
	Firm clay	15
	Sand	1
Chalk, rather soft		38
		124

At this depth the rods struck a hard rock which they could not penetrate.

2. At Mr. Michael's farm.

Record from a well-sinker in Saltfleet.

		30
Alluvium, 34 ft.	Brown silt	4
	Sand	54
Glacial Drift, 56 ft.	Clay, with stones	about 2
	Sand	about 6
Chalk, 36 ft.	Chalk rock (hard)	30
	Soft chalk, with a hard stone at the bottom	—
		126

3. Communicated by Mr. Joseph Jackling.

		Ft.
Alluvium.	Clay	27
	Black soft clay	45
	Sand	4
Glacial Drift.	Strong clay	12 to 15
	Sand	1
Chalk (very soft, like putty)		39
		129

Spalding.

(1 in. Map 70, N.S., 144 ; 6 in. Map 134 S.W.).

For account of water-works, see p. 67.

(6 in. Map 141 S.E.)

1. Boring made by Messrs. Le Grand and Sutcliff.

Communicated by Mr. G. W. Cunnington, Highfield, Spalding, to Mr. H. Preston.

———		Thickness.	Depth.
		Ft. in.	Ft. in.
Fen Beds	Quicksand	40 0	40 0
	Clay	6 0	46 0
	Shell marl	0 6	46 6
	Shingle and shells	3 0	49 6
Glacial Drift	Boulder clay	23 6	73 0

2. Spalding Common.

———		Thickness.	Depth.
		Ft. in.	Ft. in.
Alluvium.	Silt	2 6	2 6
	Clay	9 6	12 0
	Peat	1 0	13 0
	Clay	12 0	25 0

Spilsby.

(1 in. Map 84, N.S., 115; 6 in. Map 82 N.E.).

1. At house in New Spilsby, about two furlongs E.S.E. of the Church. No water found.

	Ft.
Dug and bored through blue clay (Kimeridge Clay) - - -	90

2. Another well at the "King's Head" Inn was bored to the same depth.

Stainfield.

(1 in. Map 70, N.S., 143; 6 in. Map 132 S.E.).

Boring made by Mr. Noble, 1899.

Communicated by Mr. H. Preston.

Yield good supply, but the water did not reach surface.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Great Oolite Clay	Clay - - - - -	4 6	4 6
	Rock - - - - -	1 6	6 0
	Clay - - - - -	4 0	10 0
Great Oolite Limestone	Rock - - - - -	2 0	12 0
Upper Estuarine Series	Clay - - - - -	22 0	34 0
Lincolnshire Limestone	Rock - - - - -	78 4	112 4
	Grey sand - - - -	4 6	116 10
	Rock - - - - -	13 2	130 0

Stallingborough.

(1 in. Map 86, N.S., 90; 6 in. Map, 21 N.E.).

Borings made in 1874; communicated by Mr. Fisher.

1. Outside the sea-bank 50 feet S.E. of the Signal Post next Stallingborough Creek.

		Ft.
Alluvium.	Brick clay - - - - - - - -	7
	Soft clay and warp - - - - - -	13
	Wood, silt, and soft clay - - - - -	6
	Soft warp - - - - - - - -	16
Glacial Drift.	Hard marly clay [Boulder Clay] - - - -	5
	Small gravel - - - - - - -	3
	Hard marly clay [Boulder Clay] - - - -	10
	Clean loose sand - - - - - -	4
	To Chalk - -	64

2. Inside the sea-bank, 133 yards N.W. of No. 1.

		Ft.
Alluvium	Brick clay	5
	Soft blue silt	35
	Clay and old timber	4
Glacial Drift	Hard marly clay [Boulder Clay]	3
	Small gravel and sand	3
	Hard clay, as above [Boulder Clay]	12
	Loose sand	5
	Hard clay	4
	Chalk	5
		76

3. ¼ mile N.W. of the Battery Grounds.

		Ft.
Alluvium.	Brick clay	10
	Soft blue clay	15
	Blue silt	17
	Wood and clay	2
Glacial Drift.	Loose red sand	12
	Soft clay	2
	Loose red sand	6
	Smooth brown brick clay	14
		78

Stamford.

(1 in. Map 64, N.S., 157; 6 in. Map 151, N.W.).

1. Six in. Boring at Hunt's Brewery, near Railway Station.
Made by Mr. J. E. Noble, Thurlby. 1899.
Communicated by Mr. H. Preston.
Height above O.D., 95.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	1 0	
Lincolnshire Limestone	Rock	14 0	15 0
Northampton Sands 24 feet	Clay	2 0	17 0
	Grey sand	4 0	21 0
	Yellow sand	2 0	23 0
	Ironstone	6 6	29 6
	Stone	9 6	39 0
Upper Lias 193 feet 6 inch.	Clay	155 0	194 0
	Rock	6	194 6
	Clay	38 0	232 6
Middle Lias (Marlstone) 9 feet 6 inches	Rock	1 0	233 6
	Clay	4 6	238 0
	Rock	4 0	242 0
Middle Lias Clays	Clay	52 0	294 0

Note—No water was obtained from the boring, but sometime after it was finished water broke in from the Northampton Sands. A well was sunk, 15 feet diameter and just over 30 feet deep. A pulsometer had to raise 5,000 gallons per hour whilst this well was being made. H.P.

2. Boring on Ketton Road, West of the Town.
Made by Mr. J. E. Noble, 1898.
Communicated by Mr. H. Preston.
No Water.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	1 0	1 0
Lincolnshire Limestone	Rock	45 7	46 7
Northampton Sands	Sand	8 10	55 5
	Ironstone	18 0	73 5
Upper Lias	Clay	126 7	200 0

3. Boring on Empringham Road.
Made by Mr. Noble.
Communicated by Mr. H. Preston.
No water.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Soil		1 0	1 0
Clay		1 6	2 6
Gravel		4 0	6 6
Lincolnshire Limestone	Rock	60 9	67 3
Northampton Sands	Yellow Sand	4 0	71 3
	Black Sand	7 0	78 3
	Ironstone	19 0	97 3
Upper Lias	Clay	122 0	219 3

4. Boring close to Bone Mill Farm, 1½ miles South of Stamford, on Old Oundle Road, made in 1900.
Communicated by Mr. Booth, Stamford, to Mr. Preston.
A good supply of water.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Loam	6 0	6 0
Lincolnshire Limestone	Limestone	2 0	8 0
Northampton Beds	Ironstone, mixed with sandstone	11 6	19 6
Upper Lias	Blue rock	7 0	26 6

5. Well by Tinkler's Quarry.

S. Sharp, *Quart. Journ. Geol. Soc.*, vol. xxix., 1873, p. 255.

		Ft.
Lincolnshire Limestone	Oolitic and compact limestones more or less shelly	49
Collyweston slate	Slaty rock.	

6. Well at Torkington's brickyard, half a mile to the east of the above.

Sharp, *op. cit.* p. 256.

	Ft.
Lincolnshire Limestone	74

See Analyses, p. 213.

Steeping.

(1 in. Map 84, N.S., 116; 6 in. Map 83, S.W.).

1. Recorded by J. A. Clarke.

Clay (Boulder Clay) White Gravel with water	20 ft. or more.

2. At cottage on the north side of railway, near Mill, by Halton Bridge, Great Steeping.

Information obtained by Mr. Jukes-Browne.

	Ft.
Boulder Clay	18
Gravel, with water about	2
	20

Stickney.

(1 in. Map 69, N.S., 115; 6 in. Map 90, S.W.).

From Mr. Skertchly's "Geology of the Fenland," p. 276.

Actual site not specified, probably a boring at some spot west of the village.

		Ft.	in.
Fen Beds	Clayey silt	4	0
	Peat with trees 0 to	0	6
	White sand	2	0
	Dark gravel mixed with clay and sand	6	0
Kimeridge Clay	Dark blue clay	32	0
	Very large septaria	2	0
	Dark blue clay	—	
	Over	46	6

Stoke Rochford.

See p. 213.

Strubby.

(1 in. Map 84, N.S., 104; 6 in. Map 57, S.E.).

1. At Mr. Dowse's.

Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker).

		Ft.
Glacial Drift	Clay, red and marly	30
	Sand	3
	Black clay, with small chalk and other pebbles	6
	Sand	12
		51

3. At Mr. Kelk's farm, Woodthorpe, a mile and a half west of Leesby.
Communicated by Mr. R. Harrison, of Woodthorpe.

		Ft.
Surface soil		2
Glacial Drift	Yellow silt	19
	Sand and small gravel	3
	Dark coloured clay	24
	Black clay, with small stones	38
	Sand and small gravel	6
Chalk	Loose chalk and flints ("croy")	6
		98

Sturton-by-Stow.

(1 in. Map 83, N.S., 102; 6 in. Map 60 N.E.)
Well, one quarter of mile S. of Sturton.

		Ft.
Lower Lias	Grey and brownish clay with selenite	5
	Bluish-grey clay with bluish-grey limestone (*Gryphæa*).	W.A.E.U.

Sudbrooke.

(1 in. Map 83, N.S., 102; 6 in. Map 62, S.W.).

1. Sudbrooke Holme.
Communicated by Messrs. Le Grand and Sutcliff.
Water rises to top of house. Yields 7,000 gallons per day of 10 hours

		Ft.	in.
Soil		2	0
Kellaways Beds	Stone	5	0
	Grey sand	13	0
	Blue clay	7	0
Cornbrash	Stone	4	6
Great Oolite Clay	Green clay	11	6
	Dark clay	14	0
Great Oolite Limestone	Stone	4	0
	Clay	1	0
	Shell rock	14	6
Upper Estuarine Series	Green clay	3	8
	Stone	5	4
	Clay	15	0
Lincolnshire Limestone	Stone	5	6
		106	0

2. Sudbrooke Holme.
Communicated by Messrs. Barnes and Sharpe.
Water rose above surface,

		Feet.
Oxford Clay and Kellaways Beds	Clay	25
	Hard clay	2
Cornbrash	Rock	7
Great Oolite Clay	Clay	28
Great Oolite Limestone	Rock	5
Upper Estuarine Series	Clay	10
	Black sand	13
		90

The water was no doubt derived mainly from the Lincolnshire Limestone below.

3. Farm one quarter of a mile south-west of Langworth Station.

Communicated by C. E. De Rance, *Proc. Yorksh. Geol. Polyt. Soc.* xii. 49.

Water rises nearly to surface.

		Ft.	
Boulder Clay Oxford Clay Kellaways Sand	Sunk 30, bored 60 (with water)	90	0

Sutton-on-Sea.

(1 in. Map 84, N.S., 104 ; 6 in. Map 58, S.W.).

1. Well, recorded by Dr. Correa de Serra, in *Phil Trans.*, vol. 89, p. 148 (1799). See also C. B. Rose, *Geologist*, 1843, p. 77, and Thompson's "History of Boston."

		Ft.
[Alluvium]	Clay	16
	Moor, like that of the islets	3 to 4
	Soft moor, mixed with shells and silt	20
[Glacial Drift]	Marly clay	1
	Chalk rock	1 to 2
	Clay	93
	Gravel and water (chalybeate taste)	—

2. Trial-hole, made in 1885, opposite the Sandhill, near the Church.

Surface at about high-water mark.

Communicated by Mr. R. Elliott Cooper.

		Ft.	in.
Post-Glacial	Soil	1	0
	Brown clay	7	6
	Blue clay	8	10
	Peat	1	6
	Blue clay	1	3
Glacial	Hard marly clay (not bottomed)	17	11
		38	0

3. At the new Vicarage, bored in 1879.

Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker)

		Ft.
Alluvium 26 ft.	Surface soil	3
	Soft warp clay	18
	Turf	3
	Sand and small gravel	2
Glacial Drift 53 ft.	Clay, with very small "whites"	25
	Grey sand	3
	Dark clay, with small stones	12
	Gravel (with water)	1½
	Black clay	5
	Green sand	5
	Grey sand and small gravel	1½
Chalk	Soft loose chalk	2
		81

4. Two wells, A. at Mr. Wood's, B. at Mr. Brown's, near the Inn, N. of the Church.

Communicated by Mr. J. Bingley, of Aby (well-sinker.)

		A. Ft.	B. Ft.
Alluvium	Dug in soft brown clay	7	7
	Bored in the same	33	30
	Bed of turf	3	3
Glacial Drift	Strong brown clay, with chalk stones and other pebbles	36	39
	Clean sharp sand	3	4
	Gravel	3	2
	Brown clay, with stones	21	—
Chalk		16	15
		122	100

Sutton, Long.

Sutton St. Mary's and Sutton Bridge.

(1 in. Map 69, N.S., 145 ; 6 in. Map 136 S.W.).

1. The Town and Sutton Bridge were originally supplied from shallow wells.

2. Boring.

Information from Mr. William Skelton.

		Ft.
Fen Beds	Silt and fine sand	47
	Gravel and sea shingle	10
Boulder Clay	Blue clay with small pieces of chalk and occasionally flints, about	100
Kimeridge Clay	Blue clay without chalk-stones, about	116
		273

This was the depth of the boring in 1885 when it was stopped, as no water was obtained. We were informed by Mr. W. H. Woodcock, of Long Sutton, under date October 20th, 1897, that the boring was not continued, and that the tube still remains in the ground as it was left in 1885.

3. Boring at Sutton Bridge Dock.

Communicated by Mr. S. B. J. Skertchly, 1879 (*Proc. Norwich Geol. Soc.*, vol.. i, p. 73).

		Ft.
Fen Beds	Soil	2
	Silt	8
	Black mud	3
	Silt	21
	Coarse sand	5
	Sand and gravel, mixed with vegetable matter and shells	9
		48

Swaby.

(1 in. Map 84, N.S. 103; 6 in. Map 65 S.E.).
Cottage by Windmill, three furlongs W.S.W. of Swaby.
Information obtained from the miller.

	Ft.
Dug in brown (Boulder) clay, with rubble at base	10
Bored in Chalk, grey, with pink bands	58
	68

Swallow.

(1 in. Map 86, N.S., 90; 6 in. Map 29 N.E.)
At farm one mile north-east of Church.
Information supplied to Mr. Clement Reid by Mr. Hopkins.

	Ft.
Chalk, becoming red	174
Gravel, bright (Carstone)	1
	175

Supply of water very limited and soon exhausted by pumping.

Swarby.

(1 in. Map 70, N.S., 127; 6 in. Map 115 N.W.).

1. Opposite the Church.
Information obtained by W. H. Holloway.

		Ft.	in.
[Oxford Clay]	Soil and dark clay	2	6
	Brown marly band	1	0
[Cornbrash]	Soft brown rock in bands, from six to twelve inches thick, with marly partings	2	6
	Hard blue rock, with a few marly partings	3	3
[Great Oolite Clay]	Blue clay	20	0
		29	3

2. Boring for water, close to site of old well.
Information obtained by W. H. Holloway.
Particulars below depth of 57 feet uncertain.

		Ft.	in.
	Soil	2	0
[Cornbrash]	Rock	1	6
[Great Oolite Clay, 29½ feet]	Yellow, green, and dark blue clay	29	6
[Great Oolite Limestone 24 ft.]	Hard rock	12	0
	Soft marly band	0	9
	Hard rock	2	0
	Dark blue clay	8	0
	Hard rock	1	6
[Upper Estuarine Series]	Light coloured clays	?20	0
[Lincolnshire Limestone	Rock	1	6
	Clay	0	3
	Rock	0	6
	Soft stone (a little water)	12	0
	Hard rock	?1	0
		92	6

Swaton.

(1 in. Map 70, N.S., 128 ; 6 in. Map, 116 S.W.)

1. Boring near Mr. Yarrad's premises, 1884–5.
Communicated by Mr. Jesse Clarke, of Sleaford.

Water overflows all the year round, and is distributed through the village by gravitation.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Surface soil		1	0	1	0
Fen Gravel	Yellow clay	3	6	4	6
	Wet gravel	2	0	6	6
	Wet running sand	1	6	8	0
Boulder Clay	Dark blue clay with flint stones	34	0	42	0
Oxford Clay and Kellaways Beds	Dark grey rock band (? septarium)	0	2	42	2
	Light dry blue clay	57	10	100	0
	Hard blue rock	2	0	102	0
	Clay parting	0	6	102	6
	Hard rock	7	0	109	6
	Clay parting	0	4	109	10
	Hard rock	5	0	114	10
	Strong clay	4	0	118	10
	Very hard rock	0	6	119	4
	Strong clay	3	0	122	4
	Very hard blue clay	4	6	126	10
	Strong band	0	2	127	0
Cornbrash	Hard rock	3	6	130	6
Great Oolite Clay	Strong band	2	0	132	6
	Rock	0	10	133	4
	Strong clay bands	10	0	143	4
Great Oolite Limestone, 21½ ft.	Rock with clay-partings	5	4	148	8
	Hard rock	6	8	155	4
	Clay parting	0	3	155	7
	Very hard rock	9	1	164	8
Upper Estuarine Series, 27 ft.	Blue clay	1	6	166	2
	Rock	1	0	167	2
	Blue clay	4	6	171	8
	Rock	2	0	173	8
	Dark bands	7	6	181	2
	Rock	1	0	182	2
	Dark rock-bands [? clay bands]	4	6	186	8
	Rock	0	6	187	2
	Strong rock-bands [? clay bands]	4	6	191	8
Lincolnshire Limestone	Very hard blue rock	17	6	209	2
	Blue clay parting	0	6	209	8
	Very hard blue rock	30	6	240	2
	White rock	1	0	241	2
	Light grey rock-parting	0	3	241	5
	Very hard rock	9	3	250	8

A grouping somewhat different from that adopted in the *Memoir on Jurassic Rocks*, vol. iv., p. 426, is here given.

2. A 4 in. boring carried to depth of 200 feet. Water stood between three and four feet below surface. J. Addy, *Proc. Inst. C.E.*, lxxiv. (1883), 161.

See Analyses p. 214.

Tathwell.

(1 in. Map 84, N.S., 103; 6 in. Map 56, S.W.).

1. Tathwell Hall.

Communicated by Mr. J. Bingley, of Aby (well-sinker).

	Ft.
White Chalk	54
Red Chalk	15
Brown sand (Carstone)	24
	93

2. Well in farmyard, Dovendale, about nine furlongs west of Tathwell Church.

Information obtained from the foreman.

		Ft.
[Boulder Clay]	Brown clay	10
	White and pink Chalk	5
[Red Chalk]	Red marl	5
[Carstone]	Red sand and water	1
		21

Tattershall.

(1 in. Map 70, N.S., 115; 6 in. Map, 89, S.W.)

1. At farm three-quarters of a mile west-south-west of Park House.

Information from Mr. Patchett of Park House.

		Ft.
	Soil and sandy gravel	6
Glacial Drift	Clay with stones	18
	Sand and water	1
		25

2. The well at Park House was dug and bored 30 feet through Boulder Clay, mottled blue and brown, containing flints and pebbles of hard Chalk.

Tetney.

(1 in. Map 85, N.S., 90; 6 in. Map 31, S.W.).

Communicated by Mr. Joseph Jackling.

1. Near the Blow Wells.

	Ft.
Clay (Alluvium ? and Boulder Clay)	63
Chalk	—

Water rises seven or eight feet above the surface.

2. Village.

	Ft.
Boulder Clay	81
Rock [Chalk]	—

Theddlethorpe St. Helen.

(1 in. Map 84, N.S., 104; 6 in. Map 49, S.E.).

Communicated by Mr. Robert Harrison, of Woodthorpe (well-sinker).

1. At the Rectory, bored in 1863.

		Ft.
Alluvium 46 ft.	Surface clay	6
	Soft mud	40
Glacial Drift 42 ft.	Marly clay	26
	Hard silt	6
	Dark clay, with small stones	2
	Sand	8
Chalk	White putty or soft chalk	25
		113

2. At Mr. J. P. Badley's, bored in 1870.

		Ft.
Alluvium 36 ft.	Surface clay, rather sandy	7
	Grey sand	29
Glacial Drift 42 ft.	Yellow clay (with stones ?)	about 10
	Dark clay, with pebbles and chalk stones	about 26
	Grey sand	8
Chalk	Loose chalk	5
		85

Thoresby, North.

(1 in. Map 85, N.S., 90; 6 in. Map 39, N.E.).

Communicated by Mr. Joseph Jackling.

1. At Engine Yard.

		Ft.
Glacial Drift	Clay with stones	81
	Sand (thin bed)	—
	Chalk	—

2. Near the Granby Inn.

		Ft.
Glacial Drift	Boulder Clay	48
	Gravel	10

Thoresby, South.

(1 in. Map 84, N.S., 103; 6 in. Map 65, S.E.).

Communicated by Mr. J. Bingley, of Aby (well-sinker).

1. At the shop, about 300 yards S.W. of Church.

		Ft.
Glacial Drift	Sand and gravel	9
	Clay, with layers of gravel	about 15
	Gravel	7
Chalk		6
		28

2. Well in Mr. North's garden, not far from the above.

		Ft.
Glacial Drift	Clay, with chalk and stones	21
	Sand and gravel, with water at bottom	8
		29

Thornton Curtis.

(1 in. Map 83, N.S. 80; 6 in. Map 73 S.W).
Communicated by Mr. Westaby.
1. Immediately N. of Thornton College (Abbey).

	Ft.
Sand	6
Clay	30
To Chalk	36

2. New Farm on Thornton Marsh.

	Ft.
Sand	6
Clay	42
To Chalk	48

Thorpe St. Peter.

(1 in. Map 84, N.S. 116; 6 in. Map 91 N.E.).
At Fendyke, a mile and a quarter west of the Railway Station, Thorpe Culvert.
Information obtained by Mr. Skertchly.

	Ft.
Soil and fen clay	7
Peat, full of wood	3
Clean clay [partly Boulder Clay ?]	30
Sand, with water	—
	40

Thurlby.

(1 in. Map 64, N.S., 157; 6 in. Map 146, N.E.).
1. 4½ in. boring at Kate's Bridge Farm, South of Thurlby
Made by Mr. J. E. Noble, 1902.
Communicated by Mr. Henry Preston.
Height above O.D., 24 ft.
Water overflows. Yield, 7,000 gallons per hour

———		Thickness.	Depth.
		Ft. in.	Ft. in
	Soil	1 0	1 0
Drift	Sand and clay	3 9	4 9
Cornbrash	Rock	7 0	11 9
Great Oolite Clay	Clay	15 0	26 9
Great Oolite Limestone	Rock	4 0	30 9
	Clay	2 3	33 0
	Rock	8 0	41 0
Upper Estuarine Series	Clay	25 0	66 0
	Grey marl	13 0	79 0
Lincolnshire Limestone	Rock	8 0	87 0

2. Quarter of a mile north of Kate's Bridge Farm, in old brick-field.

(1 in. Map 143; 6 in. Map 140, S.E.).

Made by Mr. Noble in 1903.

Height above O.D., 33 ft.

Flow, a little over 7000 gallons per hour, from a 4½ in. bore.

		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	1 6	1 6
Drift	Clay	4 3	5 9
	Hard sand	4 0	9 9
Oxford Clay and Kellaways Beds	Clay	3 0	12 9
	Sandstone	2 0	14 9
	Clay	10 9	25 6
Cornbrash	Rock	7 0	32 6
Great Oolite Clay	Clay	13 6	46 0
Great Oolite Limestone	Stone and Clay	8 0	54 0
	Rock	8 0	62 6
Upper Estuarine Series	Clay	24 0	86 0
	Grey marl	15 6	101 6
Lincolnshire Limestone	Rock	9 6	111 0

3. 2 in. Boring at Thurlby.

(1 in. Map, N.S., 143; 6 in. Map 140, S.E.).

Made by Mr. J. E. Noble. Date, 1898.

Communicated by Mr. Preston.

Height above O.D., 68 ft.

Water level, 16 ft. below surface.

		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay	Clay	17 0	17 0
Cornbrash	Rock	5 0	22 0
Great Oolite Clay	Clay	16 0	38 0
Great Oolite Limestone	Rock	11 10	49 10
	Clay	2 6	52 4
	Rock	4 9	57 1
Upper Estuarine Series	Clay	28 6	85 7
Lincolnshire Limestone	Rock	20 0	105 7

4. A Boring made in 1900, just west of the Church, gave 10,000 gallons per hour overflow from a 4½ in. hole. It was afterwards tubed with 2 in. tubes.

Communicated by Mr. Preston

Height above O.D., 28 ft.

——		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	2 0	2 0
Drift	Gravel	3 0	5 0
	Sand	5 3	10 3
Cornbrash	Shale	4 0	14 3
Great Oolite Clay	Clay	16 0	30 3
	Rock	3 3	33 6
Great Oolite Limestone	Clay	2 6	36 0
	Rock	8 0	44 0
Upper Estuarine Series	Clay	27 0	71 0
	Marl	12 0	83 0
Lincolnshire Limestone	Rock	6 0	89 0

5. 3½ in. Boring one and a quarter miles north of Church.

(1 in. Map, N.S., 143; 6 in. Map 140, S.E.).

Made by Mr. J. E. Noble. Date, 1900.

Communicated by Mr. Preston.

Height above O.D., 20 ft. Water overflowed.

Yield between 9,000 and 10,000 gallons per hour.

——		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil	1 0	1 0
Drift	Clay and stone	5 0	6 0
Cornbrash	Rock	5 0	11 0
Great Oolite Clay	Clay	19 0	30 0
Great Oolite Limestone	Rock	9 0	39 0
Upper Estuarine Series	Clay	25 0	64 0
	Grey marl	11 9	75 9
Lincolnshire Limestone	Rock	24 9	100 6

On February 9th, 1903, I visited this boring, and found that the water from the upper rock-bed (Cornbrash) had been tubed out and was running a constant stream into the drain. When the valve from the main supply was opened a supply of not less than 10,000 gallons per hour was running from the Lincolnshire Oolite.

Samples from this boring gave:

From Cornbrash—1·365 grains of chlorine per gallon.

From Lincolnshire Oolite—1·26 grains of chlorine per gallon. H. P.

6. 2 in. Boring ¼ mile east of Railway Station.

Made by Mr. J. E. Noble, 1897.

Communicated by Mr. Preston.

Height above O.D., 29. Water level, 12 ft. below ground.

——		Thickness.	Depth.
		Ft. in.	Ft. in.
Oxford Clay	Clay - - - -	17 0	17 0
Cornbrash	Rock - - -	5 0	22 0
Great Oolite Clay	Clay - - - -	16 6	38 6
Great Oolite Limestone	Rock - - -	11 0	49 6
	Clay - - - -	4 0	53 6
	Rock - - -	2 0	55 6
Upper Estuarine Series	Clay - - - -	28 6	84 0
Lincolnshire Limestone	Rock - - -	59 11	143 11

7. A 2 in. Boring at the Mill House, ½ mile north of Church.

Made by Mr. J. E. Noble, 1902.

Communicated by Mr. Preston.

Height above O.D., 29 ft. Water overflows.

Yield, 5,000 gallons per hour.

——		Thickness.	Depth.
		Ft. in.	Ft. in.
	Soil - - - -	2 0	2 0
Drift	Yellow sand - -	8 0	10 0
Oxford Clay	Clay - - - -	7 6	17 6
Cornbrash	Rock - - -	7 0	24 6
Great Oolite Clay	Clay - - - -	16 3	40 9
	Shale - - -	2 0	42 9
	Clay - - - -	2 0	44 9
Great Oolite Limestone	Rock - - -	7 0	51 9
Upper Estuarine Series	Clay - - - -	22 0	73 9
	Grey marl - - -	12 9	86 6
Lincolnshire Limestone	Rock - - -	20 0	106 6

I visited this Boring in Feb., 1903, and found that the pressure at a ¾ in. tap, 2 ft. above the ground, was 20 lbs. per square inch. H.P.

8. 2 in. Boring at back of the Board Schools.

Communicated by Mr. Preston.

No Water.

——		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil	1	6	1	6
Oxford Clay	Clay	3	6	5	0
	Shale	3	0	8	0
	Clay	10	0	18	0
Cornbrash	Rock	5	6	23	6
Great Oolite Clay	Clay	15	0	38	6
Great Oolite Limestone	Rock	2	0	40	6
	Clay	3	0	43	6
	Rock	7	6	51	0
Upper Estuarine Series	Clay	3	0	54	0
	Rock	4	0	58	0
	Clay	29	3	87	3
Lincolnshire Limestone and Northampton Sands	Rock	61	4	148	7
	Clay	3	6	152	1
	Rock	8	0	160	1
	Clay	16	6	176	7
	Rock	6	6	183	1
Upper Lias	Clay	53	11	237	0

9. 2 in. Boring made in 1897 by Mr. Noble, at back of his own residence.

Communicated by Mr. Preston.

No Water.

——		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Sand	5	0	5	0
Oxford Clay	Clay	12	0	17	0
Cornbrash	Rock	4	6	21	6
Great Oolite Clay	Clay	16	6	38	0
Great Oolite Limestone	Rock	11	6	49	6
Upper Estuarine Series	Clay	2	0	51	6
	Rock	3	0	54	6
	Clay	30	0	84	6
Lincolnshire Limestone and Northampton Sands	Rock	61	9	146	3
	Clay	6	0	152	3
	Rock	8	6	160	9
	Sandy Clay	15	6	176	3
	Clay	5	0	181	3
	Rock	2	0	183	3
Upper Lias	Clay	20	0	203	3

Toft.

A Boring ¼ mile east of Toft Lodge.
(1 in. Map 64, N.S., 143; 6 in. Map 140, S.E.)
Made by Mr. Noble.
Communicated by Mr. H. Preston.
Height above O.D., 100 ft. Water level, 127 ft. below surface.
Yield, very good supply.

——		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Gravel	15	0	15	0
Oxford Clay and Kellaways Rock	Clay	55	0	70	0
	Sand	8	0	78	0
	Clay	11	8	89	8
Cornbrash	Rock	4	0	93	8
Great Oolite Clay	Sandy clay	2	0	95	8
	Blue clay	15	0	110	8
	Sandstone	1	0	111	8
	Clay (Dicey)	3	0	114	8
Great Oolite Limestone	Rock	5	0	119	8
	Hard dicey clay	4	2	123	10
	Rock	1	6	125	4
Upper Estuarine Series	Clay	11	0	136	4
	Grey marl	14	0	150	4
Lincolnshire Limestone	Limestone Rock	49	4	199	8

Torrington, East.

(1 in. Map 83, N.S., 103; 6 in. Map 54, S.W.).
At Mr. Trafford's. Communicated by Mr. James Freeborough (well-sinker).

	Ft.
Yellow clay	4–5

Blue clay, with stones [Kimeridge Clay with septaria].

There was bad air with a sulphurous smell in this well. Water is often found in the beds containing the septarian stones, and in the bands of "dice."

Uffington.

(1 in. Map 64, N.S., 157; 6 in. Map 151, N.W.).
6 in. boring at back of West Hall Farm, western end of village.
Made by Mr. J. E. Noble, Thurlby, 1898.
Communicated by Mr. H. Preston.
Height above O.D. about 114 ft.

Water-level 75 feet below surface. Yield, a plentiful supply from middle of the Lincolnshire Limestone, but no increase after.

——		Thickness		Depth.	
		Ft.	in.	Ft.	in.
Soil		1	0	1	0
Cornbrash	Rock	3	6	4	6
Great Oolite Clay	Clay	18	0	22	6
Great Oolite Limestone	Rock	0	9	23	3
	Clay	1	0	24	3
	Rock	1	6	25	9
	Clay	1	3	27	0
	Rock	11	2	38	2

West Hall Farm—*continued.*

——		Thickness.	Depth.
		Ft. in.	Ft. in.
Upper Estuarine Series	Clay - - -	24 0	62 2
Lincolnshire Limestone	Rock - - -	73 4	135 6
Northampton Sands	Sand - - -	7 0	142 6
	Clay - - -	6 6	149 0
	Rock - - -	13 0	162 0
Upper Lias	Clay - - -	2 9	164 9
	Rock - - -	0 6	165 3
	Clay - - -	18 6	183 9
	Rock - - -	0 9	184 6
	Clay - - -	34 6	219 0

The yield was tested for two days by steam-power and bore-hole pump, but without finding any diminution of flow; quantity not measured.

See Analyses, p. 214.

Ulceby (by Alford).

(1 in. Map 84, N.S., 116; 6 in. Map 75, N.W.).

1. At Mr. Cartwright's farm, (Fotherington) Fordington.

Information from Mr. Cartwright of Well.

	Ft.
White and grey Chalk - - - - - - - - -	118
Red Chalk - - - - - - - - - -	12
Brown sand (Carstone) with water - - - - - -	5
	135

2. At the Grange Farm (Mr. Riggall's).

(1 in. Map, N.S., 104).

	Ft.
White and grey Chalk - - - - - - - - -	180
Red Chalk, with a little water - - - - - -	10
	190

Walcot.

(1 in. Map 70, N.S., 114; 6 in. Map 88, S.W.).

Boring made at Catley Abbey, S.W. of Walcot to depth of about 80 feet, found spring of natural "seltzer" water. (See pp., 195 201.)

Walmsgate.

(1 in. Map 84, N.S., 103; 6 in. Map 65, N.E.).

At the farm half a mile W.S.W. of the hall.

Information from the foreman.

	Ft.
Dug through clay with stones into sand [Glacial Drift] - -	36

Washingborough.

(1 in. Map 83, N.S., 114; 6 in. Map 71, S.W.).
In field a furlong west of the Church.

		Ft.
Lincolnshire Limestone	Oolitic limestone to water - -	42

Water here is obtained mostly from shallow wells.

Welby.

(1 in. Map 70, N.S., 127; 6 in. Map 114, S.E.)
Well at the Gipples, on Ermine Street.
Bored 102 feet without reaching base of Lincolnshire Limestone.

Well.

(1 in. Map 84, N.S., 104; 6 in. Map 75, N.W.).
At Mr. Cartwright's, three furlongs N.E. of the Church.
Water rose to the surface. Dug 25 feet, bored 40 feet.

		Ft.
Glacial Drift.	Clay, with stones - - - - - - - -	55
	Gravel of chalk and flints - - - - -	4
Chalk	Solid chalk - - - - - - - - -	6
		65

Welton-le-Marsh.

(1 in. Map 84, N.S., 116; 6 in. Map 75, S.E.).

1. Boothby Hall. Sand 22 ft.

2. At house, one furlong N.W. of the Church. Information from Mr. J. Tutty, well-sinker.

In clay with stones 36 ft. No water obtained.

3. At the Inn: bored 27 feet through clay into gravel, with water.

4. At houses, two furlongs N.W. of the Church, Mr. J. Tutty made two wells.

	A. Ft.	B. Ft.
Brown clay - - - - - - - - - -	6	7
Soft marl - - - - - - - - - -	10	10
Solid Chalk - - - - - - - - - -	20	23
	36	40

5. At Mill, three-quarters of a mile west of the Church.

	Ft.
White and grey Chalk - - - - - - - - -	92
Red Chalk, with water - - - - - - - - -	10
	102

6. Thwaite Hall, near Welton Wood.

		Ft.
Glacial Drift.	Clay, with stones - - - - - - - -	35
	Hard chalk gravel - - - - - - - -	12
	Sand and water - - - - - - - -	3
		50

7. Boring in village (for Skegness Water Supply).
Communicated with specimens by Mr. S. Coetmore Jones, 1904.
Height about 70 feet above O.D.
Water rose 10 feet above surface: Yield about 3,000 gallons an hour.

	——	Thickness. Ft.	Thickness. In.	Depth. Ft.	Depth. In.
Glacial Drift.	Top soil—sandy loam	1	6	1	6
	Brown chalky boulder clay	20	6	22	0
	Chalky debris	1	6	23	6
	Sand with chalky debris	0	6	24	0
	Sandy marl	1	6	25	6
	Sand	1	6	27	0
	Sand with chalky debris	2	0	29	0
	Sand with flints	8	0	37	0
	Flint gravel with hard chalk	5	6	42	6
Tealby Beds.	Brown oolitic iron-ore	0	6	43	0
	Greenish calcareous sandy bed	8	6	51	6
	Ironshot and glauconitic gritty calcareous rock, with fragment of large oyster (*Ostrea c.f. Leymerii*)	0	6	52	0
	Greenish calcareous sand	7	0	59	0
	Dark grey calcareous clay	7	0	66	0
	Brown concretionary iron-ore	0	9	66	9
	Stiff grey slightly calcareous clay	3	3	70	0
	Stiff grey clay	6	0	76	0
	Stiff dark grey clay	11	6	87	6
	Brown clay	1	6	89	0
	Grey calcareous clay	8	0	97	0
	Stiff grey clay	6	6	103	6
	Stiff bluish calcareous clay	53	0	156	6
	Hard stone including phosphatic nodules	8	6	165	0
	Dark clay	14	6	179	6
Spilsby Sandstone.	Fine grey sand	1	0	180	6
	Fine grey sandstone	1	9	182	3
	Fine silver sand: 840 galls. per hour	2	0	184	3
	Hard stone	6	10	191	1
	Coarse sand with soft beds of sandstone: 3,000 galls. per hour	16	5	207	6
	Very hard rock	1	6	209	0
	Softer rock	8	1	217	0
	Light coarse grey sand	10	11	228	0
	Light and hard blue stone	3	9	231	9
Kimeridge Clay.	Dark blue clay	8	0	239	9

Willingham, South.

(1 in. Map, 83 N.S., 103; 6 in. Map 54, S.E.).

1. At Mr. Fieldsend's, Belmont, on the eastern side of the High Street, south of the road from South Willingham to Donnington-on-Bain.
Communicated by Mr. James Freeborough (well-sinker).

	Ft.
White marl	6
Clean white sand	15
Pipe clay and sand	39
Sharp sand [? Spilsby sandstone]	15
	75

2. About 100 yards east of the Church.

		Ft.
Glacial Drift.	White marl	15
	Blue clay with chalk and flints	18
[Kimeridge clay]	Blue shale	—
		33

See p. 10.

Willoughby.

(1 in. Map 84, N.S., 116; 6 in. Map 75, N.E.).

1. At Railway Station.

Communicated by Mr. A. J. Jukes-Browne, and Mr. M. Staniland, *Quart. Journ. Geol. Soc.*, vol. xlix., p. 469, 1887.

Water rose 30 feet above surface.

Yield, good supply, 4619 gallons per hour.

	——	Thickness.	Depth.
		Ft. in.	Ft. in.
Glacial Drift 63 ft.	Red Boulder Clay, with pebbles of chalk	28 0	28 0
	Coarse red sand, with lydianite and quartz grains (water flows to surface)	22 0	50 0
	Compact sand, with chalk pebbles	1 0	51 0
	Running sand, with chalk and flint pebbles	2 0	53 0
	Angular grey sand	4 0	57 0
	Coarse red sand, with oolitic grains of iron	6 0	63 0
"Roach" Beds, 43 ft.	Light brown silty clay	4 0	67 0
	Dark ,, ,, ,,	1 0	68 0
	Light ,, ,, ,,	9 0	77 0
	Dark ,, ,, ,,	6 0	83 0
	Darker ,, ,, ,,	13 0	96 0
	Red (brown) sandstone, with oolitic iron-grains	10 0	106 0
Tealby Clay 108 ft.	Dark clay	29 0	135 0
	Lighter-coloured clay	6 0	141 0
	Blue clay, with selenite	19 0	160 0
	Sandy clay	5 0	165 0
	Brown clay	10 0	175 0
	Blue clay, darker below	11 0	186 0
	Brown clay, darker below	22 0	208 0
	Sandy clay	6 0	214 0
Ironstone Beds. 18 ft.	Red sandstone, with oolitic grains of iron	4 0	218 0
	Red sand and clay, with oolitic grains	2 0	220 0
	Dark brown clay, containing sand coated with oxide of iron	12 0	232 0

1. At Railway Station—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Spilsby Sandstone	Semi-compact sand with a broken Belemnite, shell fragments, etc.	1 0	233 0
	Compact coarse-grained sandstone	0 6	233 6
	Light grey sandstone - - -	10 6	244 0
	Dark brown, oolitic, ferruginous marlstone (water rose above surface from this depth) - -	1 0	245 0
	Fine sharp blue sand with thin bed of clay, which when pierced, water burst through, and rose 30 feet above ground *	3 0	248 0

2. At Rectory, near the Church.
Information from Mr. Tyson, of Willoughby (well-sinker).

		Ft.
Glacial Drift	Dug through gravel and clay - - -	18
	Clay with stones Sand at bottom } bored - - -	40
		58

3. At Mill, half a mile S.E. of the Church.
Information from Mr. Tyson.

		Ft.
Glacial Drift	Sunk through clay with small chalk stones, into sand - - - - - - -	15

4. At Mr. Tyson's cottage, 400 yards west of the station, the well sunk by himself.

		Ft.
Glacial Drift	Clay full of chalk stones and thin veins of sand	30
	Soft chalky clay or marl - - - -	6
	Clay, with chalk stones - - - -	12
	Sand, with water - - - - - -	2
		60

Willoughton.

(1 in. Map 83, N.S., 89; 6 in. Map 44, N.W.).
Communicated by Mr. S. Coetmore Jones.

		Thickness.	Depth.
		Ft.	Ft.
Upper Lias - -	Dug Well (probably clay)	–	24
	Black slaty shale - -	16	40
Middle Lias - -	Ironstone - - -	2	42

* Information from Mr. H. C. Cheetham, District Engineer, G. N. Railway.

Wilsford.

(1 in. Map 70, N.S., 127; 6 in. Map 105, S.E.).

1. Gatehouse on Railway.

Information from Mr Joseph Cocks.

All white rock [Lincolnshire Limestone] - - - -

Water at bottom from an open joint.

2. Copper Hill Farm.

Lincolnshire Limestone. (A few feet of water).

Wilsthorpe.

(1 in. Map 64, N.S., 157; 6 in. Map 146, N.E.).

1. Boring for Dr. Joy, about half a mile W.N.W. of village.

Made by Mr. J. E. Noble, Thurlby, Bourn. 1902.

Communicated by Mr. Preston.

Height above O.D. 55 feet; water-level 1 foot below ground.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
	Soil - - - -	1	0	1	0
Cornbrash	Stone - - -	2	6	3	6
Great Oolite Clay	Clay - - -	15	0	18	6
Great Oolite Limestone	Rock - - -	1	6	20	0
	Clay - - - -	1	0	21	0
	Rock - - -	1	0	22	0
	Clay - - -	2	0	24	0
	Rock - - -	9	0	33	0
Upper Estuarine Series	Clay - - -	20	0	53	0
	Grey marl - -	16	6	69	6
Lincolnshire Limestone	Rock - - -	34	0	103	6

2. For Peterborough Waterworks, 1888.

Communicated by J. C. Gill, *Proc. Inst. C.E.* ci. 221.

Yield of three wells per day in 1888: (1) 674,818; (2) 681,108; and (3) 810,320 (total 2,166,246 gallons).

Section of No. 3 Well.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in
	Stiff yellow surface soil	4	7	4	7
Great Oolite Clay	Dark clay - -	0	6	5	1
	Peat [Lignite ?] - -	1	0	6	1
	Bed of marine shells -	1	0	7	1
Great Oolite Limestone	Grey limestone - -	7	6	14	7
Upper Estuarine Series	Green clay - -	5	8	20	3
	Hard shale - -	1	11	22	2
	Green and dark brown clay - - -	27	9	49	11

2. For Peterborough Waterworks, 1888—*continued.*

		Thickness.	Depth.
		Ft. in.	Ft. in.
Lincolnshire Limestone	Soft rock (water-bearing)	3 3	53 2
	Hard rock - -	4 0	57 2
	Soft rock (water increased) - - -	2 0	59 2
	Hard rock - - -	0 10	60 0
	Soft rock (yield of water vastly increased) -	3 4	63 4
	Boring stopped in hard rock - - -		

The supply previously available was pumped from a well 5 feet 6 inches in diameter, and the object of the present work was to augment the quantity by constructing artesian tube-wells and discharging into that well. (*See* under Braceborough).

Yield above noted was maintained to 1890 (date of Mr. Gill's paper.) During 1889, the volume of water pumped from the well [at Braceborough] into which the borings discharge, was 523,316,410 gallons. At commencement of year, the height of water in well was 51 feet 6 inches above O.D., and at end of year 52 feet 3½ inches; the rainfall at pumping station in 1889 was 22·61 inches. The wettest month was May, when 5·01 inches of rain fell; and the maximum height of water in well (54 feet 10½ inches) was reached on June 8. The minimum height (51 feet 5 inches) was reached on October 26. J. C. GILL.

See Analyses, p. 215.

Winteringham.

(1 in. Map 86, N.S., Sheet 80; 6 in. Map, 6 N.W.),

Boring at Read's Island in the Humber.

Information supplied by Mr. Owston to Mr. Strangways.

	Ft.
Warp to bed of the Humber - - - - - -	90
Black clay - - - - - - - - - - -	3
White sand - - - - - - - - - - -	7
Blue clay - - - - - - - - - - -	5
Gravel - - - - - - - - - - -	13
Soft clay - - - - - - - - - - -	15
Fine clay - - - - - - - - - - -	27
Ironstone - - - - - - - - - - -	25
White Chalk - - - - - - - - - - -	7
	192

The water rose 2 feet 10 inches above the surface.

Winterton.

(1 in. Map 86, N.S., 80; 6 in. Map 11, N.W.)
Water obtained mostly from shallow wells.

		Ft.	in.
1. Well in limestone, thin greystone, and blue shale		48	0

2. Well at Farm on Winterton Carrs.

		Ft.	in.
Alluvium	Clay	45	0
	Gravel	0	0
		C.F.S.	

Witham-on-the-Hill.

(1 in. Map 64, N.S., 143; 6 in. Map 140, S.W.).
Boring made by Mr. Noble. Communicated by Mr. H. Preston.
Water-level 104 feet below surface: supply good.

		Ft.	in.
Glacial Drift, etc. (*Dug well*)		17	0
Great Oolite Clay and Limestone.	Alternations of rock and clay	30	9
Upper Estuarine Series.	Stone, clay, and marl	20	3
Lincolnshire Limestone.	Rock (water at depth of 122 ft.)	60	1
		128	1

Witham, South.

(1 in. Map 64, N.S., 143; 6 in. Map 138 N.E.)
Supply derived from wells in Lincolnshire Limestone, 28 to 40 feet deep; and from spring.

Withcall.

(1 in. Map 84, N.S., 103; 6 in. Map 55, N.E.)
1. At the back of Mr. Soulby's farmyard, S.W. of the Church.
Communicated by Mr. Ch. Wilkinson, of Louth (well-sinker).

	Ft.
Sunk through pink Chalk into greyish-white Chalk, without piercing the latter, but finding water at	21

2. Well near the Railway Station.
Communicated by Mr. W. H. Kirkby, Great Northern Railway.

	Ft.
White Chalk	19
Red Chalk (water at bottom)	8
	27

3. At cottage by the farmstead on Withcall Hill or "Donnington Top."
Communicated by Mr. C. Wilkinson.
Dug and bored about 150 feet through Chalk with two bands of pink chalk, finding water in dark Red Chalk at the bottom.
4. Another well at the farmstead, three-quarters of a mile north-east of Cold Harbour, is 165 feet deep, through the same beds.

Withern.

(1 in. Map 84, N.S., 104; 6 in. Map 57 S.W.)
1. About half a mile west of the Church.
Communicated by Mr. J. Bingley, of Aby (well-sinker).
Dug 24 feet, bored 66 feet.

		Ft.
Glacial Drift	Clay, with stones	78
	Sand and gravel	12
		90

2. At Mr. Well's farm, two furlongs S.E. of Church.
Communicated by Mr. Robert Harrison, of Woodthorpe, Alford.

	Ft.
Clay, with stones - - - - - - - - -	about 50
Sand - - - - - - - - - - -	,, 15
	65

Wood Enderby.

(1 in. Map 83, N.S., 115; 6 in. Map 81, S.E.).
At Mr. Vintner's farm.

	Ft.
White clay (Boulder Clay) with veins of sand near the bottom, and blue clay (probably Kimeridge Clay) below - - -	30

Woodhall.

(1 in. Map 83, N.S., 115; 6 in. Map 81, N.W.).
1. Not far from the Church.
Communicated by Mr. R. Harrison.

		Feet.
Boulder Clay and Kimeridge Clay	Clean clay with Ammonites - - - -	33
	Bored through same for - - - -	70
		103

At a depth of 33 feet a spring of salt water was tapped, resembling that of Woodhall Spa, but it gradually became less salt, and was finally replaced by a supply of fresh water.

2. Shaft and Bore-hole at Woodhall Spa. (6 in. Map 80, S.E.)

The following account of the Woodhall Spa was furnished to Dr. Granville by a physician resident at Horncastle:—

"In the year 1819, some speculators, under the idea of finding coal at Kirkstead, near Horncastle, caused a shaft to be sunk at that place, 100 yards deep; they then bored 100 yards deeper, when the works were discontinued, as it was stated, for want of money. Immediately on the discontinuance of this attempt, a gentleman, owning an estate in the parish of Woodhall, about a mile distant from Kirkstead, was induced, without previously boring, to sink a shaft, thereon of 280 yards in depth.

"Boring was then had recourse to, which was carried 120 yards deeper. when this scheme, like all the preceding ones, was abandoned as hopeless, In this trial no regular account was kept of the strata passed through, but from the information and specimens received, it appears that the sinking was commenced in the clunch clay, which was found to be 120 yards in thickness; they then passed in succession through forest marble, cornbrash, oolite, Bath freestone, lias, clunch clay again; then a rock, composed of carbonate of lime, siliceous sand, alumine, a greenish substance resembling chlorite, and a portion of mica, in which many terebratulæ were embedded [Marlstone]. In this rock, the sinking was discontinued. Of the boring no other account has been obtained than that they left off in a stone of light colour. A brine spring was found at about 170 yards deep, which was the only water met with.

"At present, the water, which is pumped up from a depth of 60 yards by iron pipes, and conveyed by pipes of the same material to a reservoir for distribution, becomes charged with the oxyde of that metal, which it possesses not in its natural state. The marble slabs in the bath are stained with the brown marks of the same." *

* The Spas of England and Principal Sea-bathing Places, by A. B. Granville, M.D., F.R.S. London, 1841, Chap. v., p. 104.

Water overflowed when the shaft was abandoned.

Putting together this information with that above given, Mr. Jukes-Browne believes this boring to have gone through the following beds, and to have terminated in a sandstone belonging to the "*A. armatus* zone" of the Lower Lias :—

	Thickness.	Depth.
	Ft. in.	Ft. in.
Gravel and Boulder Clay - - - - -	10 0	10 0
Kimeridge, Corallian, and Oxford Clays -	350 0	360 0
Kellaways Beds, Cornbrash, Great Oolite Clay and Limestone, Upper Estuarine Series - - - - - - - - -	140 0	500 0
Lincolnshire Limestone and Northampton Sands - - - - - - - - -	140 0	640 0
Lias (Upper, Middle, and part of the Lower)	380 0	1,020 0

The spring of saline water issues at a depth of 530 feet, and would, therefore, appear to be in the Inferior Oolite. The shaft is lined with brickwork to this depth.

Mr. Teague, who descended the well in March, 1884, stated to Mr. Cameron that the water stands naturally at 50 feet from the surface, and at 330 feet from the surface when the pump is at work. Pumping carried on for 26½ minutes yielded 640 gallons, lowering the water from 50 to 52½ feet from the surface. The present machinery is capable of raising 1,000 gallons per hour, but is inadequate to drain the well.

3. At the School House, Woodhall Spa.

Communicated by Mr. Dobbs of Kirkstead (well-sinker).

	Ft.
Sand and gravel, not bottomed - - - - - - -	18

4. About 200 yards north east of the Spa Hotel.

Boring made in 1877 ?

Communicated to Mr. Cameron by Mr. J. Smalley of Hull (well-sinker).

		Ft.
Boulder Clay, Kimeridge Clay, Corallian Clay, Oxford Clay	Blue bind - - - - - - -	400
Kellaways Beds, Cornbrash, etc.	Blue bind, with beds of sandstone from 2 to 3 feet thick, and 12 to 14 feet apart	120
		520

5. Boring for the Rev. J. O. Stephens, near Woodhall Spa. 1897–98. Made and communicated by Messrs. Isler & Co. to Mr. Whitaker. Water level, 42 feet below surface.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Glacial Drift	Dug well	5	0	5	0
Kimeridge and Oxford Clays	Blue clay	55	0	60	0
	Blue shale	190	0	250	0
	Light clay	175	0	425	0
	Brown clay	48	6	473	6
Kellaways Beds	Light rock	1	6	475	0
	Sandy blue clay	17	6	492	6
	Light clay	6	6	499	0
Cornbrash	Light blue rock	6	1	505	1
Great Oolite Clay	Mottled clay	7	11	513	0
	Brown clay	18	0	531	0
Great Oolite Limestone	Blue rock	10	6	541	6
Upper Estuarine Series.	Light blue clay	10	0	551	6
	Blue rock	4	0	555	6
	Light brown clay	17	6	573	0
	Blue sandy clay	5	0	578	0
Lincolnshire Limestone	Light blue rock	23	6	601	6
	Hard blue rock	45	0	646	6
Lower Estuarine Series	Hard light clay	13	0	659	6
	Light rock	8	6	668	0
	Dark brown clay	6	6	674	6
	Green clay	1	6	676	0
	Hard blue rock	1	0	677	0

6. Well at Woodhall Spa. 1904 (in progress). Made by Mr. Aldridge, well-sinker, for Mr. R. Adolphus Came. Communicated by Mr. H. Preston.

		Thickness.		Depth.	
		Ft.	in.	Ft.	in.
Glacial Drift	Sand and gravel	12	0	12	0
Kimeridge, Corallian and Oxford Clays	Soft clay	24	0	36	0
	Soft blue bind	12	0	48	0
	Soft blue bind	28	0	76	0
	Very strong grey bind with pyrites (had to be blasted)	27	0	103	0
	Rock (concretions ?)	0	7	103	7
	Strong grey bind, with fossils	15	5	119	0
	Strong grey bind, with septaria	17	0	136	0
	Strong dark blue bind	14	0	150	0
	Strong dark blue bind	15	0	165	0
	Strong grey bind	15	0	180	0
	Very tough dark blue bind (required blasting)	13	0	193	0
	Blue bind	29	0	222	0
	Blue bind, very strong	18	0	240	0

7. Well at the farm north-north-east of Tower-on-Moor, near Woodhall Spa.

Communicated by Mr. Dobbs of Kirkstead, well-sinker.

		Ft.
Glacial Drift	Clean yellow sand	36
	Gravel and shingle, no bottom	6
		42

See Analyses, p. 215.

Wroot.

(1 in. Map 86, N.S., 88; 6 in. Map 24, N.E.)

Dr. R. B. Low. 1893.

Public pump-well in village. Stated to be 22 feet deep and to yield a good supply of pure water.

Average depth of private wells about 18 feet. Some liable to pollution.

Yarburgh.

Near the Carpenter's shop.

(1 in. Map 84, N.S., 90; 6 in. Map 48, N.W.).

Communicated by Mr. Ch. Wilkinson (well-sinker), Louth.

		Ft.
Glacial Drift	Red and blue (? purple) clay	30
	Gravel	10
	Sand	9
	Blue (? purple) clay	5
	Sand and clay	1
Chalk		6
		70

ANALYSES OF WATERS.

The water-bearing strata are for the most part calcareous, and the springs and ordinary well-waters of the county contain in solution from about 12 to 30 grains of mineral matter per gallon, chiefly calcium carbonate. The Lias waters, as a rule, contain a larger amount of mineral constituents than the waters of the Oolites or Chalk, while among the Oolites the waters of the Kellaways Beds are often impregnated with an excess of mineral matter.

The character of the constituents depends naturally on the rocks traversed by the waters; and the Lias and Oolites, and some of the Cretaceous rocks and their included fossils, yield not only calcium carbonate, small quantities of magnesium and sodium carbonate, and sodium chloride, but also calcium sulphate and ferruginous compounds derived from the selenite, ironstone and pyrites that are conspicuously present in some of the strata. Sodium chloride is derived also from rain-water through the influence of strong winds from the sea carrying spray and foam.

Ordinary chalybeate springs are not uncommon along the outcrop of the ferruginous strata, but it is only here and there that they have ever risen to the dignity of a Spa, and then, as a rule, but temporarily.

The more strongly saline waters are usually deep-seated, and they may owe their constituents to the saliferous Triassic strata, or in some cases possibly in part to the percolation of sea-water. In all questions of this sort the geological structure and proximity to sea have not only to be considered, but, as Mr. W. W. Fisher points out, also the chemical argument.*

In some cases where the salinity of the water has been due to the damming up of underground waters, so that the ingredients have become concentrated, the pumping of the water may be attended by gradually lessening salinity. Waters must, in many cases, travel long distances underground, and it is likely that the argillaceous strata are less impervious at a depth than at the surface. Records of borings show that clays which are soft and absolutely impervious at the surface, may be hard and jointed shales below ground—the joints or fault planes affording facilities for the passage of water.

On this subject Dr. H. F. Parsons contributes the following notes :

"The water obtained from the Lower Oolite Series (Lincolnshire Limestone) is sometimes of a mineral character, especially where obtained by deep borings at a distance from the outcrop. Thus the water from a public well at Heckington, 400 feet deep, commencing in the Oxford Clay, contains per gallon 128 grains of mineral

* "On the Salinity of Waters from the Oolites," *Analyst*, Feb., 1904.

matter, the chlorine being 58.5 grains (=96·5 grains of common salt), while the hardness is only 3.6°. A somewhat similar water from Catley is, or used to be, bottled in an aerated state and sold for use as a table-beverage, like Apollinaris or Seltzer water, being, I believe, the only British example of such a water. (See pp. 182, 201).

"The water from a deep boring at Belmisthorpe near Stamford is of a different mineral character, it contains per gallon 107 grains of solids, but only 4·7 of chlorine and has 47° of hardness.

"The mineral character of the water obtained from the Lincolnshire Limestone varies according to the distance from the outcrop, the chlorine and total solids increasing with the distance, while the hardness diminishes, as shown in the following table in which the wells are arranged in order from N.W. to S.E.

Place.	Miles from outcrop.	Depth ft.	grs. per gallon. Total solids.	Chlorine.	Hardness.
Bourn	2	100	27·6	1·4	19·0
Tongue End	5	200	44·4	10·64	3·5
Littleworth	9	350	173·9	60·5	2·75
Crowland	13	600	200·	105·0	4·5

"A series in a different direction, but showing similar results, is given by Mr. H. Preston. (See Table, p. 198.)

"Water of a similar character (*i.e.*, containing much chloride of sodium, often also carbonate of soda), and of a but slight degree of hardness, is obtained in other places from calcareous strata covered by impermeable beds and at a distance from the outcrop, *e.g.*, in S.E. Essex from the Chalk under the Tertiary strata, and in Northamptonshire from the Marlstone under the Upper Lias and Oolite clays. But though one can understand how the water in traversing a great thickness of strata gets charged with mineral matters dissolved out of them, it is not so easy to understand how it gets rid of the carbonate and sulphate of lime. Does this crystallize out as calcite in the interstices of the rocks? Waters of this class appear to have been imprisoned in the strata for long periods of time, and hence in such a case one may doubt the permanence of the supply if much drawn upon by pumping.

"The water obtained from the New Red Sandstone beds near the N. border of Lincolnshire, especially where these beds are covered with clay and peat, and at some distance from the outcrop, contains iron in solution in the state of ferrous carbonate, and often sulphuretted hydrogen, which give it an unpleasant smell and chalybeate taste. On exposure to the air this iron is precipitated as hydrated ferric oxide, and the water, though it loses its taste and smell, becomes turbid with an unsightly brown sediment. Such water, though it may be free from sewage-pollution, is distasteful, so that more palatable water from more dangerous sources is apt

to be preferred. The iron may, however, be removed by a process of aeration and sedimentation or filtering, or by Clark's softening process. The water from the Red Sandstone in this part of the country is usually hard; much of the hardness being due to magnesia probably derived from débris of the Magnesian Limestone.

"The water obtained by bored wells from the sand and grave beds (?Pleistocene), below the laminated clay, is apt to be of similar character. (See analysis of water from public well at Luddington, p. 207.)

"The water from shallow wells above the clay is commonly polluted with sewage, but the considerable amount of organic matter which it contains is probably derived in part from vegetable remains in the soil; and it also contains rather large amounts of chlorine which may be derived from sea-salt remaining in the beds of estuarine origin. See analyses of waters from well at Eastoft and Garthorpe, pp. 202, 203." H. F. P.

It is noteworthy that the amount of mineral matter in solution in springs is liable to variation at different times.

Dr. Thresh remarks that "The total amount of saline matter permissible in a drinking water depends in a great measure upon the nature of the salts. No hard and fast line can be drawn, but the best waters rarely contain more than 20 grains of mineral matter per gallon. When 100 grains is reached the water becomes rather of the character of a 'mineral' than a 'potable' water."

In some well waters near to the sea-coast or to estuaries, a considerable amount of sodium chloride may be met with, but if the water contains not more than about 50 grains per gallon "it appears to be quite harmless."*

Hardness is due to the presence of salts of lime and magnesia. That known as temporary hardness is produced by carbonates of lime and magnesia, and chiefly by carbonate of lime. It is removable by boiling the water. Permanent hardness is caused by the sulphates of lime and magnesia.

Both sources of hardness are removable by sundry softening processes, but those applied to the permanent hardness are the more expensive.†

In the Sixth Report of the Rivers Pollution Commission (p. 21), "a sample containing 1 lb. of carbonate of lime or its equivalent of other hardening salts in 100,000 lbs. is said to have one degree of hardness. Each degree of hardness indicates the destruction and waste of 12 lbs of the best hard soap by 100,000 lbs., or 10,000 gallons of the water, when used for washing." In Clark's Table of Hardness each degree of hardness is equal to one grain of carbonate of lime per gallon. One grain of carbonate of magnesia is equal to about $1\frac{3}{4}$ grains of carbonate of lime. A soft water has less than 6° of hardness.

The scale of hardness used by the Rivers Pollution Commission can be transformed into degrees of hardness on Clark's scale by multiplying the number by seven and then moving the decimal point one place to the left. (*op. cit.*, p. 29).

* "Water and Water Supplies," by Dr. J. C. Thresh. Ed. 3, 1901, p. 124.

† *See* Thresh, "Water and Water Supplies," Ed. 3, p. 288.

ANALYSES OF WATERS FROM RIVERS, SPRINGS AND BORINGS.

EXPRESSED IN PARTS PER 100,000.

Water collected from / Date	I. River Glen after great accession of spring water. April 24, 1876.	II. Springs forming Bourn "Well Head." Nov. 22, 1873.	III. Bourn Water Works derived from a Boring. Nov. 22, 1873.	IV. Boring near Braceborough Spa supplying City of Peterborough. Feb. 26, 1876.	V. Spalding, old water supply from springs. Nov. 24, 1873.	VI. Lincoln water from River Witham. July 12, 1873.	VII. Boston water supply from streams near Miningsby. July 15, 1873.	VIII. Podehole, Deeping Fen Drainage. Nov. 24, 1873.
Temperature, Fahrenheit	42°	51°	49°	52°	—	—	—	—
Total solid impurity	39·100	42·920	42·760	40·500	28·48	18·88	19·88	110·40
Organic Carbon	—	0·104	0·217	0·089	·179	·286	·152	1·327
„ Nitrogen	—	0·020	0·047	0·025	·043	·038	·033	·159
Free Ammonia	0·010	—	—	—	—	—	—	·080
Albuminoid Ammonia	0·042	—	—	0·002	—	—	—	—
Nitrogen or nitrates and nitrites / Oxidised nitrogen	— 0·340	— —	— —	— —	— —	·095 —	— —	— —
Total combined Nitrogen	—	0·020	0·047	—	·043	·133	·033	·225
Previous sewage or animal contamination	—	—	—	—	—	630·	—	340.
Chlorine	1·350	3·100	2·100	1·950	2·70	3·60	2·15	12·75
Hardness–Temporary	17·700	23·400	23·400	21·500	8·0	·4	10·6	25·2
„ Permanent	5·300	11·800	11·800	6·700	9·7	7·6	3·8	42·1
„ Total	23·000	35·200	35·200	28·200	17·7	8·0	14·4	67·3
Remarks	Very turbid	Clear and palatable	Clear and palatable	—	Clear	Turbid.	Turbid.	Turbid.

I. and IV. published by J. Addy, *Proc. Inst., C.E.*, lxxiv., 1883, p. 149.
II., III., V.-VIII. published in 6th Report, Rivers Pollution Commission.

ANALYSES OF DEEP WELL-WATERS IN SOUTH LINCOLNSHIRE.

By Dr. J. C. Thresh.

Results in Parts per 100,000

	1 Crowland. (Linc. Limestone.)	2 Market Deeping. (Linc. Limestone.)	3 Thurlby. (Gt. Oolite.)	4 Thurlby. (Lincolnshire Limestone.)	5 St. James Deeping. (Linc. Limestone).	6 Caythorpe (Marlstone.)	7 Near Peterborough (L. Limestone)
Colour	Lt. Yellow	Lt. Yellow	V. F. Yellow	F. Yellow	F. Yellow	Yellow	None
Odour	None	None	None	None	None	None	None
Appearance	Little deposit ox. iron	Clear	Clear	Clear	Clear	Clear at first, V. turbid after	Bright
Chlorine	153·0	13·6	2·4	2·4	20·5	4·0	5·4
Permanent hardness	0·0	1·4	8·0	8·0	2·0	12·0	4·0
Temporary do.	6·0	7·6	15·0	17·0	7·6	22·0	16·0
Total ditto	6·0	9·0	23·0	25·0	9·6	34·0	20·0
Nitrites	0·0	0·0	trace	0·0	0·0	0·0	0·0
Nitric nitrogen	0·1	0·06	0·03	0·06	0.06	0·06	0·05
Iron	trace	0·0	0·0	0·0	0·0	1·5 (Oxide)	0·0
Free ammonia	0·160	0·056	0·004	0·002	0·080	0·014	0·020
Organic ammonia	·002	0·003	0·003	0·003	0·001	0·003	0·006
Oxygen absorbed	·083	0·072	0·039	0·029	0·025	0·020	0·013

Full Analysis of Solids.

	1 Crowland.	2 Market Deeping.	3 Thurlby.	4 Thurlby.	5 St. James Deeping.	6 Caythorpe.	7 Near Peterboro'h
Carbonate of calcium	5·5	8·65	23·7	24·0	8·15	34·75	20·25
Carbonate of magnesium	3·15	3·5	—	—	3·65	·65	3·5
Sulphate of calcium	—	—	3·4	6·45	—	—	—
Sulphate of magnesium.	—	—	3·75	3·5	—	6·5	—
Sulphate of sodium	16·3	8·7	4·6	1·65	8·2	25·45	10.35
Sulphate of potassium	—	—	—	—	1·1	—	—
Chloride of sodium	244·2	22·45	3·95	3·95	33·3	6·6	8·9
Carbonate of sodium	50·75	20·3	—	—	22·1	—	5·05
Carbonate of iron	·35	—	—	—	—	2·2	—
Nitrates, silica, etc.	3·25	·4	1·1	1·45	2·0	1·05	2·85
	323·5	64·0	40·5	41·0	78·5	77·2	50·9

None of these contained more than a trace of nitrates, and they are all very pure organically.

* Reprinted from paper read by Mr. H. Preston before the *Brit. Assoc. of Waterworks Engineers*, 1903. See also Dr. Thresh, "The Examination of Waters and Water Supplies," 1904, pp. 307, 322, &c.

Allington.

Salt well.

Aswarby Spa.

Saline chalybeate. 480 grains of mineral matter per gallon (Dr. T. Short). Probably from Kellaways Beds.

Aunsby.

304 grains mineral matter per gallon. (Dr. T. Short). Probably from Kellaways Beds.

Bardney.

Communicated by the Local Government Board.

1. Analyses of Water from Bardney New Well (36 feet deep in Drift gravel, n manured allotment-ground).

No. 1. 23 October, 1900.
No. 2. 30 May, 1901.
No. 3. 26 August, 1901 after 14 days' pumping.

	No. 1.	No. 2.	No. 3.	
Total Solids	42.0	49·0	32·2	grains per gallon.
Chlorine	2·9	2·9	2·4	
Free Ammonia	·0028	·007	·0014	
Albuminoid Ammonia	·0140	·0126	·0056	
Oxygen required to oxidize organic matter	·0728	—	·0336	
Nitrogen as Nitrates	·42	—	·35	
Temporary hardness	10·	—	9·25	degrees
Permanent hardness	12·	—	4·75	
Total hardness	22·	—	14·00	

CHARLES HARRISON.

2. Analysis of water from Bardney Well after 14 days pumping received 23rd January, 1903.

(New Well 25 feet deep in old river terrace gravel over boulder clay).

Total Solids	26·6 grains per gallon
Chlorine	1·5 ,, ,,
Oxygen required to oxydize organic matter	·084 ,, ,,
Nitrogen as Nitrate	trace
Free Ammonia	·02 parts per million
Albuminoid Ammonia	·06 ,, ,,
Temporary hardness	12·0 degrees
Permanent hardness	3·2 ,,
Total hardness	15·2 ,,

The solid residue left on evaporation was white and did not blacken on ncineration.

The analysis shows no sign of contamination by organic matter and the water is suitable for domestic use.

CHARLES HARRISON.

Barrowby.

See Report to Local Government Board, by Dr. H. F. Parsons. 1890. At that date many of the wells were found to be polluted.

Billingborough.

(W. H. Dalton, in Geology of S.W. Lincolnshire, p. 158).

At Billingborough there is a remarkably strong spring constantly in a state resembling ebullition, and said to be the origin of the name "Boilingborough." It evolves large quantities of gas, consisting of—

Carbonic acid	3·43
Oxygen	4·14
Nitrogen	92·43
In volumes	100·00

A gallon yields the following solid ingredients :—

	grains.
Carbonate of lime	14·66
,, magnesia	0·41
,, iron	0·61
,, potash	0·44
,, soda	2·11
Sulphate of lime	6·91
,, potash	0·37
Chloride of magnesium	1·32
,, potassium	0·15
Silica	0·66
Nitrate of ammonia	trace
Phosphoric acid	trace
Organic matter	trace
	27·64

Twenty-five yards distant is a strong chalybeate spring, close to which is a third regarded as of medicinal value.* These are derived probably from Kellaways Beds.

Boston.

See Table, p. 197.

Bourn.

Lincolnshire Limestone Water.

Sample of water from Bourn Well-head, analysed by Dr. John C. Thresh, July, 1903. (See also Table p. 179.)

Communicated by Mr. H. Preston.

	parts per 100,000	
Calcium carbonate	22·8	
,, sulphate	10·2	
Magnesium sulphate	4·12	
,, chloride	0·91	
Sodium chloride	2·49	
Sodium nitrate	0·46	
Silica, &c.	0·52	
Total solids dried at 180°c.		41·5
Temporary hardness	18·2	
Permanent ,,	9·4	
Total ,,	27·6	
Organic ammonia	·003	
Oxygen absorbed in 4 hours at 27°c.	·014	
Nitrites	nil	

* J. W. Kynaston, in *Journ. Chem. Soc.*, 1860, vol. xii., pp. 57–62.

Braceborough Spa.

North of railway-station and village. (*See also* Table, p. 197).

Rises through black peaty soil, about six feet deep, resting on gravel and Great Oolite series.

Analysis by Dr. H. W. Hake.

Gases evolved—

Carbonic acid.
Oxygen.
Nitrogen.
Chlorine (a little).

Yields—

Carbonate of lime.
Sulphate of lime.
,, soda.
Chloride of sodium.

Bracebridge.

Trial bore-hole for Messrs. Bass & Co.

	Grains per gallon.
Sodium chloride	549·00
Sodium bromide	11·00
Sodium carbonate	15·00
Calcium carbonate	12·50
Magnesium carbonate	4·58
Calcium sulphate	1·13
Silica	0·35
Iron oxide, Alumina, Phosphoric acid	0·21
Suspended matter	0·04
	593·81

"As this boring commenced in the Lower Lias, near the top of that deposit, which is at least 800 feet thick, the saline water must either be derived from the Lower Lias, or must have flowed up along the plane of some fault or joint from the Keuper Marls below."*

Catley Abbey, S.W. of Walcot.

"Only natural British seltzer water."

Water obtained from depth of 80 feet from beds below Oxford Clay.

(see pp. 182, 195).

Cawthorpe, near Bourn.

Saline chalybeate spring in middle of street, 160 grains mineral matter per gallon (Dr. T. Short).

Probably from Kellaways Beds.

Deeping.

See Table, pp. 197, 198.

* C. E. De Rance, *Proc. Yorksh. Geol. and Polytechn. Soc.*, xii. 1891, p. 49; *Rep. Brit. Assoc.* for 1891, p. 302.

Dry Doddington.

Communicated by the Local Government Board.

1. Sample from a well in Lower Lias. Composition per 100,000 parts.

Chlorine	37·2
Sulphuric Acid	168·44
Nitric Acid	10·00
Free Ammonia	0·0047
Albuminoid Ammonia	0·0148
Total solid matter	427·6
Phosphoric Acid	None

The above figures show that the water is saturated with mineral salts, mainly sulphate of lime. These give to the water a nauseous and bitter taste, and absolutely prevent its use for household purposes.

Organically also the water is not pure, although, as the well is shallow and new, the organic pollution could probably be prevented.

As the the water is evidently derived from a soil largely composed of sulphate of lime (Gypsum) it will, in my opinion, be impossible to obtain drinkable water from it unless the strata yielding the lime can be penetrated.

OTTO HEHNER.

April 12th, 1893.

2. Water from subsoil drains in loamy clay over Lias.

100,000 parts of the sample were found to contain—

Chlorine	1·50
Sulphuric Acid	7·00
Nitric Acid	1·32
Free Ammonia	0·0078
Albuminoid Ammonia	0·0123
Total Solids	41·24
Loss on ignition	4·96
Phosphoric Acid	None

The water when received was somewhat turbid, and this fact doubtless accounts for the albuminous organic matter being rather higher than is considered advisable.

OTTO HEHNER.

June 28th, 1893.

Eastoft.

Water from well sunk by Crowle Local Board in site of old river Don. Well shallow in alluvial deposit.

Total solids	160	grains per gallon.
Chlorine	10·5	„ „
Hardness, before boiling	42°	
„ after boiling	20·5°	
Free ammonia	19·0	parts per million.
Albuminoid ammonia	1·3	parts per million.

H. F. PARSONS.

April 29th, 1875.

Gainsborough.

1. Spring, south-east of town; saline, chalybeate and sulphurous. Probably from Rhætic Beds.

2. Analyses of Water from New Red Sandstone. Communicated by Mr. H. Preston.

See also Dr. Mair's Report to Local Government Board on Urban District of Gainsborough, 1899,

Results given in parts per 100,000.	*BOREHOLE No. 1.* Dr. Percy Frankland September, 1893.	*BOREHOLE No. 1.* Dr. Muter. February, 1900.	*BOREHOLE No. 2.* Dr. Muter. February, 1900.	Averages of 28 samples from New Red Sandstone. Rivers Pollution Report, 1874.
Total Solids	59·50	58·00	87·28	30·63
Chlorine	2·30	2·71	7·00	2·94
Nitrogen as Nitrate, etc.	0·004	None	Trace.	0·717
Albuminoid Ammonia	None	0·005	0·006	Not given.
Ammonia	0·001	0·003	0·005	·0003
Hardness				
Temporary	14·00	17·57	18·57	7·40
Permanent	8·40	19·57	15.71	10·50
	22·40	37·14	34·28	17·90
Appearance, &c.	Turbid Palatable	Colorless Clear.	Pale Yellow Slightly turbid.	Generally clear. Palatable.

Garthorpe.

1. Water from shallow well in alluvial soil by site of old river Don.
Water clear with yellowish tinge.

Total solids	122	grains per gallon.
Chlorine	14·4	„ „
Nitric acid	very much	
Iron	0	
Hardness before boiling	78°	
„ after boiling	65°	
„ due to magnesia	65°	
Free ammonia	·04	parts per million.
Albuminoid ammonia	·38	

H. F. PARSONS.

November 30th, 1878.

2. Water from well 20 feet deep in surface soil and sand near site of old river Don.
Water clear and colourless, free from taste and smell.

Total solids	135	grains per gallon.
Loss on ignition	30	„ „
Chlorine	23·2	„ „
Nitric acid	much	
Iron	considerable	
Hardness before boiling	60°	
„ after boiling	44°	
„ due to magnesia	48°	
Free ammonia	·34	parts per million.
Albuminoid ammonia	·24	

June 14th, 1876.

H. F. PARSONS.

Grantham.

Spittlegate. Chalybeate water.
50 grains mineral of matter per gallon (Dr. T. Short).
From sand and gravel over Middle Lias.

Grimsby.

Analyses from the 6th Report of the Rivers Pollution Commission.

	Grimsby Blow Wells. 10th Jan. 1873. (Temperature, 7·2 C.).	Grimsby Well at Docks 300 feet, 10th Jan. 1873. (Temperature, 11·5 C.).
Total Solid Impurities	27·26	32·40
Organic Carbon	·028	·025
Organic Nitrogen	·003	·007
Ammonia	·001	—
Nitrogen as Nitrates and Nitrites	·267	107
Total Combined Nitrogen	·271	·114
Previous Sewage or Animal Contamination	2·360	750·00
Chlorine	1·80	5·00
Hardness, temporary	14·3	14·5
Hardness, permanent	6·3	7·6
Hardness, total	20·6	22·1
		Clear and palatable.

Haverholme.

Near Alnwick, N.E. of Sleaford.
Medicinal spring.
Probably from Kellaways Beds.

Haxey.

South Carr Bore (see p. 108.)

Communicated by the Local Government Board.

From a report by Messrs. Fairbank, Civil Engineers, on proposed water-works for Thorne.

	Grains per gallon. (parts 70·000).
Appearance	Clear
Hardness	20·0°
Chlorine	15·4
Nitrate	None
Total Solid Residue	46·90
Loss on Ignition	10·50
Free Ammonia	·011
Albuminoid Ammonia	·0007
Oxygen consumed in two hours at 100°C.	·109

Heckington.

Analyses by Dr. Alfred Ashby. 1892.

The results of the analyses are expressed in parts per 100,000.

Chlorine	83·80	82·70
Equal to common salt	138·09	136·28
Nitrous acid	0·00	
Nitric acid (N_2O_5)	0·15	
Phosphoric acid	very faint trace	
Sulphuric acid	traces	
Total solids dried at (115° C.)	181·64	180·96
Free ammonia	·1220	·0996
Albuminoid ammonia	·0044	·0097
Lead and copper	absent.	
Total hardness	3·64	
Permanent hardness	1·74	
Temporary hardness	1·90	

The analyses show that this is a very pure and soft water, but that the saline matter (equal to 127 grains per gallon) is very high, and gives it a brackish flavour.

On this account it is not fitted for a domestic supply.

Hemswell.

North of village. Chalybeate spring from Northampton Beds.

Horncastle.

1. Water (for boiler-purposes) received from Horncastle Rural District Council, 6th June, 1896.

Analysis by Mr. J. Muter, 18th June, 1896.

	grains per gallon.
Silica	·56
Carbonate of lime	·7
Sulphate of lime	928·2
Carbonate of magnesia	1·4
Total incrusting solids	95·48
Non-incrusting solids	385·42
Total solids	480·9

This water is unfit for use in a steam-boiler as, it contains far too much saline matter.

From well at sewage-farm, at the depth of 40 feet. Shaft, 60 feet; bored, 30 feet. Fair supply.

2. Analysis of Water Company's water by the Clinical Research Association, London.

Communicated by the Local Government Board.

Colour in 2 ft. tube	yellowish green
Suspended matter	very minute in amount
	grains per gallon
Total Solid Residue (dried at 120°)	17·15
Combined Chlorine	1·30
Expressed as Common Salt	2·14
Nitrogen as Nitrates	0·53
Nitrites	absent

2. Analysis of Water Company's water by the Clinical Research Association, London—*continued.*

	grains per gallon.
Saline Ammonia	traces only
Albuminoid Ammonia	0·00049
Oxygen required to oxidise the Organic matter	0·0130
Hardness (in degree)	13·4°
Lead or Copper	absent

The above analytical results are satisfactory, and the water may be quite safely used for drinking purposes.

Kingerby Spa.

South of village, by Kingerby Wood.

Chalybeate spring, which seems to issue from the base of a lenticular bed of sand which here intervenes between the Boulder Clay and the Oxfordian. (A. J. Jukes-Browne, in *Geol. Lincoln,* p. 135).

Leadenham.

Communicated by Mr. H. Preston.

Water from the Lower Lias; band of ironstone belonging to zone of *Ammonites semicostatus.* There is evidence that this band thins out eastwards, in which case the water would be retained in a stagnant condition.

	grains per gallon.	parts per 100,000
Calcium carbonate	25·9	37·0
Calcium sulphate	·8	1·15
Magnesium sulphate	41·9	59·9
Sodium sulphate	130·8	186·9
Sodium chloride	277·2	396·0
Nitrates, etc. (traces)	·3	·35
	476·9	·681·3

JOHN C. THRESH, D.Sc.

Nov. 6th, 1904.

Leasingham.

Report on a sample of water from Leasingham Boring, for Sleaford R.D. Council, June 14th, 1901, by Mr. J. Clare.

Communicated by the Local Government Board.

Results expressed in parts per 100,000.

Chlorine	1.70
Nitrous Acid	0·00
Nitric Acid (N_2O_5)	2·42
Sulphuric Acid ($S.O_3$)	3·68
Phosphoric Acid	very faint trace
Total Solids	36·40
Free Ammonia	·0065
Albuminoid Ammonia	·0060
Temporary hardness	17·73
Permanent hardness	9·96
Total hardness	27·69
Lead and Copper	absent

This is a good and pure water. It is hard, but that is a character belonging to limestone waters. A large portion of the hardness may be removed by boiling the water for about half an hour.

ALFRED ASHBY.

Luddington.

Water from public well sunk by Goole Rural Sanitary Authority near site of old river Don.

Well 24 ft. deep, made watertight with large stoneware pipes as far down as clay bed, and bored to depth of 57 ft. from surface, through the clay into brown sand with some pebbles. Water clear when first drawn, with strong chalybeate taste and smell; on standing it became very turbid, but free from taste or smell.

	I. April 14th, 1876.	II. May 30th, 1878.
	grains per gallon	
Total solids	75	79
Loss on ignition	23	22
Chlorine	10·8	9·4
Nitric Acid	0	0
Iron	much	·1
Hardness, before boiling	27°	—
„ after boiling	12°	—
„ due to magnesia*	17°	—
	parts per million	
Free Ammonia	·86	1·94
Albuminoid Ammonia	·09	·08

H. F. PARSONS.

Monkswell, Lincoln.

South-east of Monk's Abbey.

Chalybeate spring, temperature 51° (air 60°). (Dr. A. B. Granville).

From Middle Lias.

Nettleton.

Sample of Water received from Mr. Septimus P. Skipworth, on the 6th day of October, 1897.

Communicated by the Local Government Board.

	grains per gallon
Total solid residue	19·80
Chlorine	1·30
	parts per million
Free Ammonia	·0266
Albuminoid Ammonia	·0480
Temporary hardness	10·1°
Permanent „	3·5°
Total „	13·6°

JAS. BAYNES.

Oct. 7th, 1897.

Osbournby.

Calcareous spring with tufa-deposit north-east of village.

* The hardness due to magnesia is that remaining after precipitation of the lime by ammonium oxalate.—H.F.P.

Potter Hanworth.

Analysis of water from a bore-hole, 31st October, 1901.
Communicated by the Local Government Board

	grains per gallon.
Total Solid Residue	30·8
Chlorine	1·8
Nitrogen as Nitrates and Nitrites	·15
Oxygen absorbed	·04
	parts per million.
Free Ammonia	·01
Albuminoid Ammonia	·06
	Degrees.
Temporary Hardness	16·
Permanent Hardness	4·
Total Hardness	20·

The residue left on evaporation was white and did not blacken on incineration.

CHARLES HARRISON.

November 12th, 1901.

Quarrington.

Analysis of water from a boring on the site of the new Lunatic Asylum at Quarrington (see p.) received from Mr. Jesse Clare, of Seaford.
Results expressed in parts per 100,000

Sulphuric acid ($S.O_3$)	14·12
Chlorine	2·56
Nitrous acid	0·00
Nitric acid (N_2O_5)	1·34
Phosphoric acid	Faint trace
Total solids in solution	62·16
Free ammonia	·0000
Albuminoid ammonia	·0058
Oxygen absorbed from permanganate at 80° F. in ¼ hour	·0158
Oxygen absorbed from permanganate at 80° F. in 4 hours	·0273
Temporary hardness	20·1
Permanent ,,	20·4
Total ,,	40·5
Lead and Copper	absent

This water is remarkably pure, containing as it does only a very minute quantity of organic matter. It is, however, very hard, the total solid being high, and unfortunately the permanent hardness is very great, constituting about half of the total hardness.

The hardness could be reduced to nearly one-half by the use of lime, or to a still greater extent in other ways.

ALFRED ASHBY,

March 5th, 1898.

Roxby-cum-Risby.

Communicated by Mr. H. Preston.

1.—Risby Warren. Lincolnshire Limestone water.

Analysis made by Professor J. A. Wanklyn, October 17th, 1894.

Bore Water.

	grains per gallon.
Carbonate of lime	16·0
Sulphate of lime	2·4
Nitrate of magnesia	2·0
Chloride of sodium	2·1
	22·5

Hardness, 19·5 degrees. No poisonous metals.

	Parts per million.
Free ammonia	0·08
Albuminoid ammonia	0·04

This is water of first class organic purity, perfectly free from sewage. It is good drinking water but is rather hard.

2.—Warren Beck Water.

	grains per gallon.
Carbonate of lime	11·5
Sulphate of lime	2·9
Nitrate of magnesia	2·0
Chloride of sodium	2·1
	18·5

Hardness 15·5 degrees. No poisonous metals.

	parts per million.
Free ammonia	0·00
Albuminoid ammonia	0·02

This is water of first rate organic purity, perfectly free from sewage. It is a good drinking water. It is softer than the bore water and for general domestic and town use is to be preferred.

3.—Risby Warren.

Dr. Muter's Analysis September 12th, 1902.

This water was colourless and clear.

Description of Sample. From experimental well 22 feet deep.

Odour when heated to 100° F.	None
Chlorine	1·30
Nitrogen as nitrates	Slight traces.
Ammonia	0·0105
Albuminoid ammonia	0·0035
Oxygen absorbed by organic matter in { 15 minutes at 88° F.	0·0090
Oxygen absorbed by organic matter in { 4 hours at 80° F.	0·0120
Total solids (dried at 228° F.)	25·20
Hardness, degrees of Clark's Scale—	
Before boiling	19·2
After boiling	3·6

Microscopical examination of deposit—Mineral matter.

This should prove an excellent water for public supply.

JOHN MUTER.

Ruskington.

Analysis of water from boring September 15th, 1899. J. Clare.

Communicated by the Local Government Board.

Results expressed in parts per 100,000.

Chlorine	1·80
Nitrous acid	0·00
Nitric acid (N_2O_5)	0·10
Sulphuric acid (SO_3)	4·23
Phosphoric acid	very faint trace.
Total solids	36·96
Loss on ignition of ditto	2·88
Free ammonia	·0007
Albuminoid ammonia	·0028
Temporary hardness	17·80
Permanent hardness	9·06
Total hardness	26·86
Lead and copper	absent
Colour and appearance in 2 foot tube, pale greenish blue; clear.	
Odour at 100° Fahrt.	none
Deposit	none

This is a palatable and exceedingly pure water without any suspicion of sewage-contamination. It is hard, but that is a character natural to limestone waters, whilst it is much less so than the polluted surface well waters of the district.

ALFRED ASHBY.

Scredington.

Analysis of water from boring, 219 feet through Oxford Clay into Lower Oolites. (See p. 152). Jesse Clare, 22nd April, 1897.

Communicated by the Local Government Board.

Results expressed in parts of 100,000.

Chlorine	1·50
Nitrous acid	0·00
Nitric acid (N_2O_5)	0·09
Sulphuric acid (SO_3)	4·23
Phosphoric acid	faint trace
Total solids in solution	38·32
Free ammonia	·0066
Albuminoid ammonia	·0048
Oxygen absorbed from permanganate at 80°F. in ¼ hour.	·0077
Oxygen absorbed from permanganate at 80°F. in 4 hours	·0164
Permanent hardness	7·4
Temporary hardness	22·2
Total hardness	29·6
Lead and Copper	absent
Iron	a trace mostly in the deposit.
Odour at 100° F.	none

ALFRED ASHBY.

Scunthorpe.

Water from Bunter Sandstone.

A. Analyses by Messrs. Stanger and Blount, November, 1901.

1. Analysis for Organic Impurity.

	grains per gallon.
Total solids	388·50
Chlorine	91·23
	parts per 100,000.
Free ammonia	0·021
Albuminoid ammonia	0·001
Oxygen absorbed after four hours	0·01
Nitrogen as nitrites	nil
„ „ nitrates	0·36

2. Analysis for Mineral Constituents.

	grains per gallon.
Silica (SiO_2)	1·15
Alumina, Ferric oxide ($Al_2O_3 + Fe_2O_3$)	0·28
Lime (CaO)	77·84
Magnesia (MgO)	24·89
Soda (Na_2O)	27·08
Carbonic anhydride (CO_2)	1·45
Sulphuric anhydride (SO_3)	86·18
Nitric anhydride (N_2O_5)	0·97
Chlorine	91·23
	311·07
Deduct Oxygen equivalent to chlorine	20·56
	290·51
Combined water, organic matter and loss	97·99
Total Solids	388·50

The chief salts present are probably therefore:—

	grains per gallon.
Calcium carbonate ($CaCO_3$)	3·30
Calcium sulphate ($CaSO_4$)	146·51
Calcuim chloride ($CaCl_2$)	31·25
Magnesium chloride ($MgCl_2$)	53·83
Magnesium nitrate ($Mg(NO_3)_2$)	1·33
Sodium chloride (NaCl)	51·10
	287·32

From these analyses it appears that the water although organically pure, is loaded with saline constitutents, and that it is unfit for a town's supply.

B. Analyses by Dr. J. Muter, November, 1901.

1. Analysis for Mineral Constituents

	grains per gallon.
Calcium sulphate	146·72
Calcium carbonate	2·45
Calcium chloride	25·63
Magnesium carbonate	0·53
Magnesium chloride	63·20
Potassium chloride	5·25
Sodium chloride	58·45
Ferric oxide	0·52
Silica	0·70
	303·45

This water was colourless and clear.

Examined for sanitary purposes it was found to be free from organic contaminations as evidenced by the following figures:

2. Analysis for Organic Impurity.

	grains per gallon.
Albuminoid ammonia	0·0021
Oxygen consumed in fifteen minutes	0·0089
Oxygen consumed in four hours	0·0201
Nitrogen as nitrites or nitrates	None.

Unfortunately its high saline contents render it unsuitable for a public water-supply.

Sempringham.

Priory.

32 grains of mineral matter per gallon. (Dr. T. Short).
Probably from Kellaways Beds.

Spital (in the Street) Spa.

Between Glentham and Hemswell.
Chalybeate.

Stainfield,

N.W. of Bourn.

264 grains of mineral matter per gallon. (Dr. T. Short),
Other wells containing mineral matter are mentioned.*

*See Geol. S.W. Lincolnshire, p. 155.

Stamford.

Probably from Northampton Sands.

Chalybeate.

Sample of water from the River Welland, 1 mile above Stamford.

Analysed by Dr. John C. Thresh, M.D., D.Sc., F.I.C. July, 1903.

Communicated by Mr. H. Preston.

		parts per 100,000
Calcium carbonate		19·8
Calcium sulphate		8·15
Magnesium sulphate		3·05
Magnesium chloride		1·6
Sodium chloride		2·65
Organic matter, nitrates, &c		1·75
Total solids at 180° C.		37·00
Temporary hardness	17·0	
Permanent hardness	8·0	
Total hardness	25·0	
Free ammonia		·006
Organic ammonia		·020
Oxygen absorbed in 4 hours at 27° C.		·174
Nitrites		*nil.*

Stoke Rochford.

Analysis of water from the waterfall (Lincolnshire Limestone) in Stoke Park. Analysed by Dr. John C. Thresh, M.D., D.Sc., F.I.C. July, 1903.

Communicated by Mr. H. Preston.

		parts per 100,000
Calcium carbonate		18·7
Calcium sulphate		5·8
Magnesium sulphate		·5
Magnesium chloride		1·54
Sodium chloride		1·07
Sodium nitrate		3.00
Silica, &c.		·49
Total solid constituents dried at 130° C.		31·0
Temporary hardness	15·1	
Permanent hardness	6·	
Total hardness	21·1	
Free ammonia		·003
Organic ammonia		·005
Oxygen absorbed in 4 hours at 27° C.		.032
Nitrites		*nil.*

Swaton.

Analysis by Mr. Alfred Ashby, M.B., of water taken on September 7th, 1885, from a boring 261 feet deep.

The results are expressed in parts per 100,000.

Chlorine	1·50
Sulphuric acid (SO_3)	5·5073
Phosphoric acid	very faint trace
Nitrous acid	0·000
Nitric acid (N_2O_5)	0·000
Free ammonia	·0052
Albuminoid ammonia	·0042
Oxygen absorbed from permanganate in 15 mts. at 80°Fahr.	·0070
Oxygen absorbed from permanganate in 4 hrs. at 80°Fahr.	·0168
Total solids in solution	38·00
Loss on ignition of total solids	2·20
Total hardness	27·80
Permanent hardness	5·10
Temporary hardness	22·70
Lead, Iron and copper	absent
Sulphuretted hydrogen	absent
Colour and appearance in 2 foot tube	clear pale blue
Smell when heated to 100° Fahr.	none
Behaviour of residue on ignition	darkens slightly
Reaction of residue left after evaporation	very slightly alkaline
Microscopical appearance of sediment	*nil*
Taste	cool and palatable

The analysis shows that this water is extremely pure and without suspicion of pollution of any description. Like all limestone-waters it is hard, but it is much less so than the water obtained from the polluted surface-wells of the district. It is well adapted for a public supply.

Uffington.

Analysis of water from boring 219 feet deep in Lower Oolites, received from Mr. F. Dickinson, Chemist, St. Mary's Street, Stamford.

Communicated by the Local Government Board.

Total solid matter	Grains per gallon	30
Free ammonia	Parts per million	none
Albuminoid ammonia	,, ,, ,,	slight traces
Nitrogen as nitrites and nitrates	Grains per gallon	slight traces
Chlorine	,, ,, ,,	2·0
Degrees of hardness		23.5
Metals, Lead or Copper		none

There being an entire absence of free ammonia and only slight traces of nitrogen and albuminoid ammonia with a small amount of chlorine present, in our opinion the water is of average purity and one well suited for drinking and other purposes.

JOHN RICHARDSON & Co., Leicester, Limited.

H. N. B. RICHARDSON, B.A., F.C.S., Director.

November 2nd, 1898.

Walcot Spa.

N.W. of Billinghay.

256 grains of mineral matter per gallon. (Dr. T. Short).

Washingborough.

Analyses of water from shallow wells in alluvium and gravel are given in the sixth Report of the Rivers Pollution Commission (1868) 1874, p. 88.

Willingham, North.

Medicinal spring.

From Drift on Kimeridge Clay.

Willoughby.

An analysis of well water for Great Northern Railway, Locomotive Department (per Mr. H. C. Cheetham).

	parts per million.
Ammonia free	0·430
Ammonia albuminoid	0·047
Mineral Constituents	**grains per gallon.**
Silica	0·67
Iron oxide	traces
Chalk	1·92
Carbonate of magnesia	2·37
Common salt	2·96
Sodium and potassium carbonates	20·88
Sodium sulphate	traces
Total Solids	28·80

The water is clear and bright and free from taste or smell; it is a good water for engine and domestic purposes, being soft and free from pollution. The hardness is 6·5°. A water containing so much sodium and potassium carbonates is peculiar in character.

J. W. YOUNG.
Doncaster.

February 16th, 1893.

Wilsthorpe,

(Water for Peterborough).

The Analysis by Professor Wanklyn.*

The water was of first-class purity organically.

	parts per million
Free ammonia	0·14
Albuminoid ammonia	0·05
Total organic matter	2·40

Poisonous metals absent.

One gallon contains:	Grains.
Silica	0·5
Carbonate of lime	16·5
Sulphate of lime	2·0
Sulphate of magnesia	4·3
Chloride of sodium	2·9
	26·2

Hardness 23° (temporary down to 6°.)

Nitric acid 0·1 grain per gallon.

* J. C. Gill, *Proc. Inst. C.E.*, ci. (1890), 220.

Woodhall Spa.

From an account by Dr. Robert Barnes in "The Climates and Baths of Great Britain." vol. i. 1895, p. 575.

The well, according to Mr. R. B. Latham, yields 1,100 gallons per hour "After three week's cessation of pumping, the water stood at 122 feet below the surface, and *much below the level of the sea.* He also inferred, judging from the temperature of the water, 56°F. at a depth of 140 feet from the surface, that there is every probability that the water comes from the depth indicated, namely, about 500 feet. It is not at all unlikely," adds Mr. Latham, "that the spring has a direct connection with the sea."

The following is the result of an analysis made by Sir E. Frankland in 1891

"The water was collected on the 22nd of May last. It was very turbid when drawn from the well, but became clear on standing for about ten days, the deposited reddish matter consisting almost entirely of hydrated peroxide of iron. The sp. gr. of the clear water at 50°F. was 1·0165. The water tested soon after collection contained neither free iodine nor arsenic.

100,000 parts of the clear water left, on evaporation and drying at 340°F. a solid residue of 2262·4 parts, from which the following constituents were obtained:

	Parts.
Soda (Na_2O)	1037·0
Potash (K_2O)	1·06
Lime (as carbonate)	8·59
Total lime (CaO)	77·70
Magnesia (as carbonate)	1·61
Total magnesia	49·94
Alumina and peroxide of iron	·29
Ammonia (NH_3)	·94
Organic carbon	·064
Organic nitrogen	·078
Nitrogen, as nitrates or nitrites	0·00
Silica (SiO_2)	·85
Sulphuric anhydride (SO_3)	6·57
Chlorine	1351·38
Bromine	4·71
Iodine	·57

"These constituents probably exist in the water in the form of the following compounds:—

	Parts.
Carbonate of lime ($CaCO_3$)	15·34
Sulphate of lime ($CaSO_4$)	11·17
Chloride of calcium ($CaCl_2$)	127·87
Carbonate of magnesia ($MgCO_3$)	3·38
Chloride of magnesium ($MgCl_2$)	114·79
Chloride of sodium (NaCl)	1950·75
Bromide of sodium (NaBr)	4·22
Bromide of potassium (KBr)	2·13
Iodide of potassium (KI)	·75
Silicate of soda (Na_2SiO_3)	1·72

"One hundred thousand parts of the water deposited on standing 0·99 parts (dried at 212°F.) of suspended matter, consisting chiefly of peroxide of iron. On ignition this suspended matter lost 0·12 part."

A previous analysis by Professor Wanklyn, made in December, 1886, gave the following result :—

	Grains per gallon.	Reduced to parts per 100,000
Chloride of sodium	1,333·00	1,900·00
Chloride of calcium	111·00	158·56
Chloride of magnesium	91·20	130·28
Carbonate of soda	10·00	14·28
Sulphate of soda	·30	·43
Nitrate of soda	·55	·78
Free iodine	·20	·28
Iodine (as iodates)	·20	·28
Iodine (as iodides)	·40	·56
Bromine (as bromides)	3·40	4·85
Peroxide of iron	traces	traces

Dr. Barnes, after referring to the differences in the analyses, observes that "the question arises whether the supply of iodides and bromides is constant and uniform." In an analysis by Frankland in 1874 the amount of iodine in 100,000 parts was ·880, and of bromine 6·280; in an analysis by Messrs Wright & Burton in 1883, the iodine was ·5216 and the bromine 4·9729.*

It is interesting to find that, not far from the church at Woodhall, at a depth of 33 feet, "a spring of salt water was tapped, resembling that of Woodhall Spa, but it gradually became less salt, and was finally replaced by a supply of fresh water."†

ANALYSES OF KIMERIDGE CLAY FROM BENNIWORTH.

Communicated by Mr. J. Stuart Bogg.

The following analyses of cores and samples from the Benniworth boring (see p. 48) were made by Mr. F. W. Richardson, F.I.C., F.C.S., City Analyst for Bradford :—

1. Sample of dark clay, from depth of 78 ft. 2 in., received Mar. 4th, 1904.

	Moist sample.	Dry sample (burnt.)
Free moisture	29·08	—
Water of hydration	10·00	—
Ammonia	—	—
Alumina	13·19	21·65
Iron protoxide	3·42	5·61
Lime carbonate	12·81	21·02
Magnesia	—	—
Silica	31·50	51·72
	100·00	100·00

* *See* Geology of Lincoln (Geol. Survey), pp. 208, etc.
† A. Strahan, in Geol. Lincoln, p. 205.

2. Sample of clay bluish, with fossils, from depth of 97 ft. 2 in. Received Mar. 16th, 1904.

	Moist sample.	Dry sample. (burnt.)
Free moisture	20·00	—
Water of hydration	6·70	—
Ammonia	—	—
Alumina	20·14	27·48
Iron protoxide	4·96	6·77
Lime carbonate	2·80	3·82
Magnesia	—	—
Silica	45·40	61·93
	100·00	100·00
Iron and alumina silicates	70·5%	90·18%

This is much better than the previous sample, as it contains only a small quantity of lime carbonate, and consists of clay to the extent of 96 per cent.

3. Two samples of shale. Received April 28th, 1904.

	No. 1.	No. 2.
Moisture	7·00	6·00
Water of hydration and organic matter	16·50	28·00
Mineral matter	76·50	66·00
	100·00	100·00

Composition of the mineral matter :—

Silica	50·96	43·18
Alumina	23·88	30·80
Iron protoxide	5·22	7·74
Chalk	12·42	18·28
Magnesia	1·41	
Alkalies, etc.	6·31	
	100·00	100·00

By distillation :—

Ammonia (NH_3)	·05 per cent.	·06 per cent.
Equal ammonia sulphate	·19 per cent.	·23 per cent.
per ton	4¼ lbs.	5¼ lbs.
Heavy oils	3·00 per cent.	6·1 per cent.
Light oils	7·75 per cent.	3·2 per cent.
	10·75	9·3

This is a very poor yield of ammonia, as one ton of an average shale would yield ammonia equal to about 25 lbs. of sulphate of ammonia.

The yield of oils is fairly satisfactory when we consider the fact that only a small quantity was available for distillation. On a larger scale the amount of oils obtained would be greater.

4. Two samples of clay. No. 1 sample was from a 13 in. seam at the depth of 306 ft., and No. 2 from a 12 in. seam at the depth of 309¾ ft. Received April 29th, 1904.

	No. 1.	No. 2.
Per cent. of total sulphur on the moist clay	3·95	5·35

These are very high percentages.

F. W. RICHARDSON.

BIBLIOGRAPHY.

1. GEOLOGICAL SURVEY PUBLICATIONS ON LINCOLNSHIRE.

Sheets of the Index Map. Scale, four miles to one inch.

5. Wroot.
6. North Lincolnshire, including Epworth, Kirton-in-Lindsey, and Caistor.
9. Central and South Lincolnshire.

Sheets of the Map. Old Series. Scale one inch to a mile.

64. Stamford, Market Deeping.
65. Portion of Fenland.
69. Boston, Wainfleet, Holbeach, Sutton St. Marys.
70. Sleaford, Tattershall, Grantham, Spalding.
83. Gainsborough, Market Rasen, Lincoln, Horncastle.
84. Louth, Alford, Spilsby, Skegness.
85. Grimsby.
86. Barton-upon-Humber, Brigg, Crowle, Epworth, Kirton-in-Lindsey, Caistor.

Memoirs, 8vo.

1875. JUDD, J. W.—The Geology of Rutland and the parts of Lincoln . . . . included in Sheet 64.

1877. SKERTCHLY, S. B. J.—The Geology of the Fenland.

1885. JUKES-BROWNE, A. J.—The Geology of the south-west part of Lincolnshire. (Explanation of Sheet 70).

—— REID, C.—The Geology of Holderness, and the adjoining parts of Yorkshire and Lincolnshire. (Explanation of Sheet 85).

1887. JUKES-BROWNE, A. J.—The Geology of East Lincolnshire, including the country near the towns of Louth, Alford, and Spilsby. (Explanation of Sheet 84).

1888. USSHER, W. A. E., A. J. JUKES-BROWNE, and A. STRAHAN. In part from Notes by W. H. PENNING, W. H. DALTON, and A. C. G. CAMERON.—The Geology of the Country around Lincoln. (Explanation of Sheet 83).

1890. USSHER, W. A. E. Parts by C. FOX-STRANGWAYS, A. C. G. CAMERON, C. REID, and A. J. JUKES-BROWNE.—The Geology of North Lincolnshire and South Yorkshire. (Explanation of Sheet 86).

1893. WHITAKER, W., S. B. J. SKERTCHLY and A. J. JUKES-BROWNE.—The Geology of South-Western Norfolk and of Northern Cambridgeshire [including the south-eastern end of the Lincolnshire Fenland]. (Explanation of Sheet 65).

1893–95. WOODWARD, H. B.—The Jurassic Rocks of Britain, vol. III. The Lias of England and Wales (Yorkshire excepted), 1893; vol. IV. The Lower Oolitic Rocks of England (Yorkshire excepted), 1894; vol. V. The Middle and Upper Oolitic Rocks of England (Yorkshire excepted), 1895.

1899. WHITAKER, W. and A. J. JUKES-BROWNE.—The Geology of the Borders of the Wash, including Boston and Hunstanton. (Explanation of Sheet 69).

1900–1904. JUKES-BROWNE, A. J., with contributions by WILLIAM HILL.—The Cretaceous Rocks of Britain, vol. I. The Gault and Upper Greensand of England, 1900; vol. II. The Lower and Middle Chalk of England, 1903; vol. III. The Upper Chalk of England, 1904.

2. REPORTS OF MEDICAL INSPECTORS OF PRIVY COUNCIL AND LOCAL GOVERNMENT BOARD ON LINCOLNSHIRE.

(Communicated by Dr. H. F. Parsons.)

In the Annual Reports of the Medical Officer (Sir J. Simon) to the Privy Council, reports by Medical Inspectors on the following Lincolnshire localities were referred to :—

1864. BRISTOWE, DR. On Fever at Grantham.
1868. THORNE, DR. R. THORNE. On Epidemic of typhoid fever at Winterton.
1870. RADCLIFFE, NETTEN. Fever at Ingham.
—— —————— Fever at Scothern.
—— —————— Fever at Stamford.

Of these reports only extracts or abstracts were published. All had to do with the prevalence of typhoid fever, and in each case polluted water is given as one of the causes.

1880. PARSONS, Dr. H. F. Report on the Sanitary Condition of the Sutton Bridge Urban Sanitary District.

1881. PARSONS, Dr. H. F. Report on the Sanitary Condition of Great Grimsby.

1882. PARSONS, Dr. H. F. Report on an Outbreak of Diphtheria at Gedney Drove End, and on Enteric Fever at Whaplode Drove, in the Holbeach Rural Sanitary District.

1883. PARSONS, Dr. H. F. Report on the prevalence of Scarlet Fever and Diphtheria in the Thorne Registration District, and on the general Sanitary condition of the Districts comprised therein. (Refers to Crowle and the Isle of Axholme.)

1885. GRESSWELL, Dr. D. ASTLEY. Report on two Outbreaks of Enteric Fever in the Rural Sanitary District of Lincoln.

————————Report on the Prevalence of Diphtheria in the Rural Sanitary District of Glanford Brigg.

————SPEAR, JOHN. Report on the prevalence of Diphtheria in the Spilsby Rural Sanitary District.

1888. PAGE, Dr. D. Report on the Sanitary State of the adjoining Urban Sanitary Districts of Clee-with-Weelsby and Great Grimsby, with reference to the Prevalence of Enteric Fever there.

1890. PARSONS, Dr. H. F. Report on an Epidemic of Pneumonia at Scotter, Lincolnshire, and in the neighbouring places.

————————Report on the Water Supply of Barrowby, in the Grantham Rural Sanitary District.

1893. LOW, Dr. R. BRUCE. Report on the circumstances of the River Trent in Lincolnshire and part of Nottinghamshire, with special reference to the Water Supplies of Populations resident on or near the banks of the river, and to the occurrence amongst those Populations of Enteric Fever.

1894. REECE, Dr. R. J. Report on Cholera in 1893 in Grimsby and in Cleethorpes with Thrunscoe. (In Report of Medical Officer, Loc. Gov. Board, on Cholera in England in 1893.)

1895. EVANS, E. Report upon an Outbreak of Diphtheria in the town of Holbeach.

1898. WHEATON, Dr. S. W. Report on outbreaks of Diphtheria at Marston, Hougham and Long Bennington, in the Claypole Rural District.

1899. MAIR, Dr. L. W. DARRA. Report upon the Sanitary Circumstances and Administration of the Urban District of Gainsborough, with special reference to the prevalence of Fever therein.

———LOW, Dr. R. B. Report on an Outbreak of "Fever" in the village of South Witham, in the Grantham Rural District, South Lincolnshire.

1901. COPEMAN, Dr. S. M. Report on the General Sanitary Circumstances and Administration of the Borough of Boston.

3. OTHER BOOKS AND PAPERS ON WELLS AND BORINGS IN LINCOLNSHIRE.

1734. SHORT, T. The Natural, Experimental, and Medicinal History of the Mineral Waters of Derbyshire, Lincolnshire, and Yorkshire. 4to. Lond.

1782. ENGLEFIELD, Sir H. C. Account of the Appearance of the Soil at opening a Well at Hanby in Lincolnshire. *Phil. Trans.* lxxi. 345, 346.

1787. LIMBIRD, JAMES. An Account of the Strata observed in sinking for Water at Boston, in Lincolnshire. *Phil. Trans.* lxxvii. 50–54.

1824. CRAGG, J. Account of Well, in Dr. A. Wesburgh's Sketches of Sleaford. 8vo. Sleaford.

1856. THOMPSON, P. History and Antiquities of Boston. (Well-section.) 4to London.

1860. KYNASTON, J. W. Analysis of the Water of a Spring at Billingborough, Lincolnshire. *Journ. Chem. Soc.*, ser. 2, xii., 57–62.

1867. CUFFE, R. The Woodhall or Iodine Spa, Lincolnshire. 8vo. London.

1868. WHEELER, W. H. A History of the Fens of South Lincolnshire. 8vo. Boston. Ed. 2, 1894. (Water Supply, pp. 467, etc.)

1874. WILSON, J. M. Well-sinking in the Lincolnshire Fen district. *Geol. Mag.* 143, 480.

1878. MILLER, S. H. and S. B. J. SKERTCHLY. The Fenland Past and Present. (Notes on Water Supply, pp. 429, etc.) 8vo. Wisbech.

———WHEELER, W. H. Arterial Drainage and the Storage of Water. *Journ. R. Agric. Soc.* xiv. 1.

1879. BEAVAN, F. W. Boring at Sutton Bridge Dock, Lincolnshire. *Proc. Norwich Geol. Soc.* i. 73.

———DE RANCE, C. E. Fourth Report of the Committee for Investigating the Circulation of the Underground Waters. *Rep. Brit. Assoc.* for 1878, 382–419.

———WHEELER, W. H. Rainfall, Water Supply and Drainage of Lincolnshire. (*Paper read at Lincoln, at the Meeting of the Chamber of Agriculture.*)

1881. DE RANCE, C. E. Sixth Report of the Committee for Investigating the Circulation of the Underground Waters. . . *Rep. Brit. Assoc.* for 1880, 87–106.

1882. ANON. The Boring for Coal near Goole. *Coll. Guard.* xliii. 345.

———DE RANCE, C. E. The Water Supply of England and Wales. 8vo. Lond.

1883. ADDY, JOHN. The Water Supply for Peterborough. *Proc. Inst. Civ. Eng.* vol. lxxiv. pp. 146–162.

1884. PILBROW, J. Some Particulars of an Artesian Well bored through the Oolitic Rocks at Bourn, Lincolnshire, in 1856. *Proc. Inst. Civ., Eng.* lxxv. 245.

———WRIGHT, W. T. and T. BURTON. Analysis of Woodhall Spa water *Journ. Chem. Soc.* xlv. 168.

1890. GILL, J. C. Artesian Wells in South Lincolnshire. *Proc. Inst. Civ. Eng.* ci. 218–221.

1892. DE RANCE, C. E. On the Underground Waters of Lincolnshire. *Proc. Yorksh. Geol. Soc.* xii. 22–51.

1893. JUKES-BROWNE, A. J. On some recent Borings through the Lower Cretaceous Strata in East Lincolnshire. *Quart. Journ. Geol. Soc.* xlix. 467–478.

———ANON. Artesian bored tube well at Bourne, Lincolnshire. *Engineering*, November 24, p. 649.

1894. ANON. Remarkable Overflowing Artesian Well [Bourne.] *Engineer*, lxxvii. 23, 24.

1898. MARTIN, E. A. Artesian Well at Bourn. *Sci. Goss.*, n.s , vol. v., p. 143.

1900. GRIFFITH, P. Report on proposed boring at Boultham. *Water*, vol. ii., pp. 57–61.

1903. PRESTON, H. On a new Boring at Caythorpe (Lincolnshire). *Quart. Journ. Geol. Soc.*, vol. lix., pp. 29-32.

—— ———Notes on the Geology and Underground Water Supply of South Lincolnshire. Supp. to *Contract Journal*, Aug. 19th, pp. 1-8; *Trans. Brit. Assoc. Waterworks Engineers*, vol. viii., pp. 98–134.

1904. Woodward, H. B. The Jurassic Limestones of Britain [in reference to Water Supply] *xie. Congres Internat. d'Hygiene et de Démographie, Bruxelles.*

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